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Assessment of 1978 Water Quality Conditions in the Upper Potomac Estuary

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16. ABSTRACT

The second successive intensive monitoring program in the Potomac Estuary was performed by the Annapolis Field Office, U.S. E.P.A., during the period of July to September, 1978. This program consisted of three distinct elements: (1) slack tide sampling over a sixty-five mile reach of the upper estuary; (2) sampling of the effluents at the eight major wastewater treatment plants in the Washington Metropolitan Area and (3) special field and laboratory studies which addressed specific aspects of the dissolved oxygen budget for mathematical modelling purposes as well as the chronic problem of eutrophication. The relevant findings and conclusions that were generated as a result of this data (including appropriate comparisons with the previous year) along with a tabulation of the raw data are presented in this report.

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Sediment Oxygen Demand Diurnal (Δ) DO First Order Reaction Biochemical Oxygen Demand Algal Elemental Composition Potomac Estuary	High/Low Slack Water Rate Limiting Nutrient N to P Atomic Ratios Drouge Study Pseudanabaena Catenota	

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March 1980

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DISCLAIMER

This report has been reviewed by the U.S. Environmental Protection Agency and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

This report is dedicated to the memory of Charlotte Gannett, founder and president of the Montgomery Environmental Coalition, whose untiring dedication to the environmental movement in general and the Potomac in particular will long be remembered by the rest of us who strive towards a better understanding of this complex estuary.

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City of Arlington
Piscataway, Washington Suburban Sanitary Commission
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Hunting Creek, Fairfax County
Dogue Creek, Fairfax County
Pohick Creek, Fairfax County

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CHAPTER I

INTRODUCTION AND DESCRIPTION OF STUDY

The challenge to improve the Potomac Estuary through reduction of point source pollutant loadings necessitates the periodic collection of field data to assess trends and the nature and scope of existing water quality stresses. AFO's ongoing efforts to improve and refine its predictive mathematical models imposes still another need for the acquisition of extensive water quality information. It is within these contexts that AFO embarked on its second successive intensive monitoring program in the Potomac in 1978. It seems axiomatic that there is never sufficient water quality data to answer all of the complex questions confronting us since natural systems are unpredictable. There is nevertheless a vital need for the decision makers to be kept informed of scientific data and technical findings to ensure a rational and defensible course of action. The intent of this report is to present findings and conclusions along with tabulations and graphs of the data from our 1978 studies. In many instances these findings and conclusions will be contrasted with those documented during 1977 [1]. The fact that significant data bases were obtained during two successive summers having different characteristics such as river flow allows for many comparisons to be made and better insight of water quality behavior.

The actual monitoring program covered the period from July 17 to September 27, 1978. In most respects it closely paralleled the study performed in 1977, and in others it served as an extension to further

the knowledge in particular areas or to eliminate data gaps. The three principal elements of this program are described below.

1. Ambient Water Quality Monitoring

A total of 13 slack water boat runs were made from the Route 301 Bridge to Chain Bridge. These were normally scheduled twice per week on alternate weeks. The stations sampled during each run were identical to those of the 1977 survey and are presented in Table 1. Table 2 shows the dates, times and other relevant information pertaining to each of the individual slack water runs.

The parameters that were analyzed during the 1978 ambient monitoring program were largely the same as 1977, with the most notable exception being that DO was run at two depths (surface and 5 feet) instead of one. Other differences included more filtered nutrient analyses in 1978, but no herbicides data. All of the monitored parameters are contained in Table 3.

2. STP Effluent Monitoring

This effort too was identical to what was performed during the 1977 survey in that 24 hour composite effluent samples were collected from the eight major wastewater treatment facilities on the same day as the slack water runs. Analyses were completed for the same nutrient fractions shown in Table 3 along with turbidity, BOD_5 and ultimate BOD. The latter two parameters were run on an alternate basis because of laboratory constraints. In addition, wastewater flow measurements were taken in order to compute loadings.

3. Special Studies

Those studies of a special nature that were an integral part

TABLE 1

1978 POTOMAC ESTUARY SAMPLING STATIONS

Station Number	NAME	RMI*
P-8	Chain Bridge	0
P-4	Above Windy Run (opposite Georgetown Reservoir)	1.90
1	Key Bridge	3.35
1-A	Memorial Bridge	4.85
2	14th Street Bridge	5.90
3	Hains Point	7.60
4	Bellevue	10.00
5	Woodrow Wilson Bridge	12.10
5-A	Rosier Bluff	13.60
6	Opposite Broad Creek	15.20
7	Fort Washington (Piscataway)	18.35
8	Dogue Creek - Marshall Hall	22.30
8-A	Opposite Gunston Cove	24.30
9	Chapman Point - Hallowing Point	26.90
10	Indian Head	30.60
10-B	Deep Point - Freestone Point	34.00
11	Possum Point	38.00
12	Sandy Point	42.50
13	Smith Point	45.80
14	Maryland Point	52.40
15	Opposite Nanjemoy Creek	58.55
15-A	Mathias Point	62.80
16	Route 301 Bridge	67.40

*Miles below Chain Bridge

TABLE 2

Potomac Slack Water Runs
July - September, 1978

Date	Tide	Start Time	End Time	River Flow (cfs)
7/17	LWS	0900	1340	6050
7/19	LWS	1050	1545	6090
8/01	LWS	1200	1500	9330
8/03	LWS*	1040	1520	7190
8/14	HWS*	1140	1615	16500
8/16	LWS	0940	1450	14500
8/28	HWS*	1230	1650	3250
8/30	LWS	1120	1400	4040
9/05	HWS	0900	1100	5530
9/11	HWS	1045	1525	2660
9/13	LWS	0800	1240	2760
9/25	HWS	1045	1500	2290
9/27	-	0850	1520	2190

*Slightly ahead of slack

TABLE 3

Parameter List
1978 Potomac Study

Nitrogen Series

TKN (filtered and unfiltered)
NH_3
$NO_2 + NO_3$

Phosphorus Series

Total PO_4 (filtered and unfiltered)
Inorganic PO_4

Carbon Series

Total Organic C (filtered and unfiltered)

Biological

Chlorophyll a
Phytoplankton Counts & Identification*

Physical

Temperature
Turbidity
Secchi Disc
Salinity
Conductivity
pH

Oxygen Series

BOD_5*
BOD ultimate*
DO (surface and 5 feet)

*Performed on a selective basis

of the Potomac monitoring program are briefly described below. They were designed and conducted to define or refine particular inputs to a mathematical model or to acquire specific knowledge concerning the dissolved oxygen budget and algal effects.

a. Drogue Studies

On a monthly basis a floating drogue was used to identify a parcel of water within a critical segment of the Potomac Estuary (Rosier Bluff - Piscataway) over a diurnal sampling period. Hourly samples were collected while following the drogue and analyzed for DO and chlorophyll.

b. Algal Species Identification and Cell Counts

As mentioned previously (Table 3) selected algal samples were collected during the study and visually analyzed under a microscope for identification and quantification purposes.

c. Long Term BOD Delineation Study

The purpose of this laboratory study was to obtain a further breakdown of the BOD components to include not only the carbonaceous and nitrogenous fractions but the algal fraction as well. An in-depth knowledge of BOD behavior will facilitate a better analysis of both effluent and river data, including cause and effect relationships, as well as a more precise representation of this parameter in the model. A separate report has already been published by Slayton and Trovato [2] which documents the results of this study and the procedures followed.

d. Algal Elemental Composition Analysis

Concentrated samples of algal cells collected from the Potomac Estuary were analyzed in the laboratory to obtain further

information concerning the relative quantities and atomic ratios of total (i.e. both protoplasmic and stored) carbon, nitrogen and phosphorus associated with a given bloom condition.

e. SOD Study

Numerous measurements of the oxygen demand attributable to bottom sediments were made using a specially designed benthic respirometer. In addition, a general bottom mapping survey was conducted throughout the upper estuary to assist in the interpretation of the individual SOD results.

Two other special studies (i.e. Light/Dark Bottle DO Measurements and Low Flow DO Profiling below Chain Bridge) were contemplated during the course of this program but were not completed because of unsatisfactory ambient conditions.

CHAPTER II

FINDINGS AND CONCLUSIONS

A. Physical

1. The most significant difference between the 1977 and 1978 study periods was the magnitude of the freshwater flows to the Potomac Estuary. These hydrographs are depicted in Figure 1. The 1977 study occurred under low flows (≈ 1500 cfs - average) whereas the summer of 1978 was characterized by higher and more erratic flows, which were a major driving force in terms of water quality behavior. River flows during the 1978 study period ranged from 35,000 cfs to 2,200 cfs with an average of 6,900 cfs.

2. An analysis was made of the 1977 and 1978 rainfall data which was collected by the U.S. Weather Service at Washington National Airport and shown in Figures 2 and 3. During the 1977 study period about 6.4 inches of rainfall occurred as compared to about 7.4 inches for 1978. An examination of the 1977 and 1978 hydrographs for the Potomac River indicated that the nature of the storm events must have been quite different since the rainfall quantities were fairly similar. It appears that the 1977 storms were generally of the localized (thunderstorm) variety, which did not substantially affect the base flow in the river. These could produce a significant non-point source loading to the estuary from the Washington Metropolitan Area without the benefit of added dilution and flushing. The 1978 storms, on the other hand, were probably more

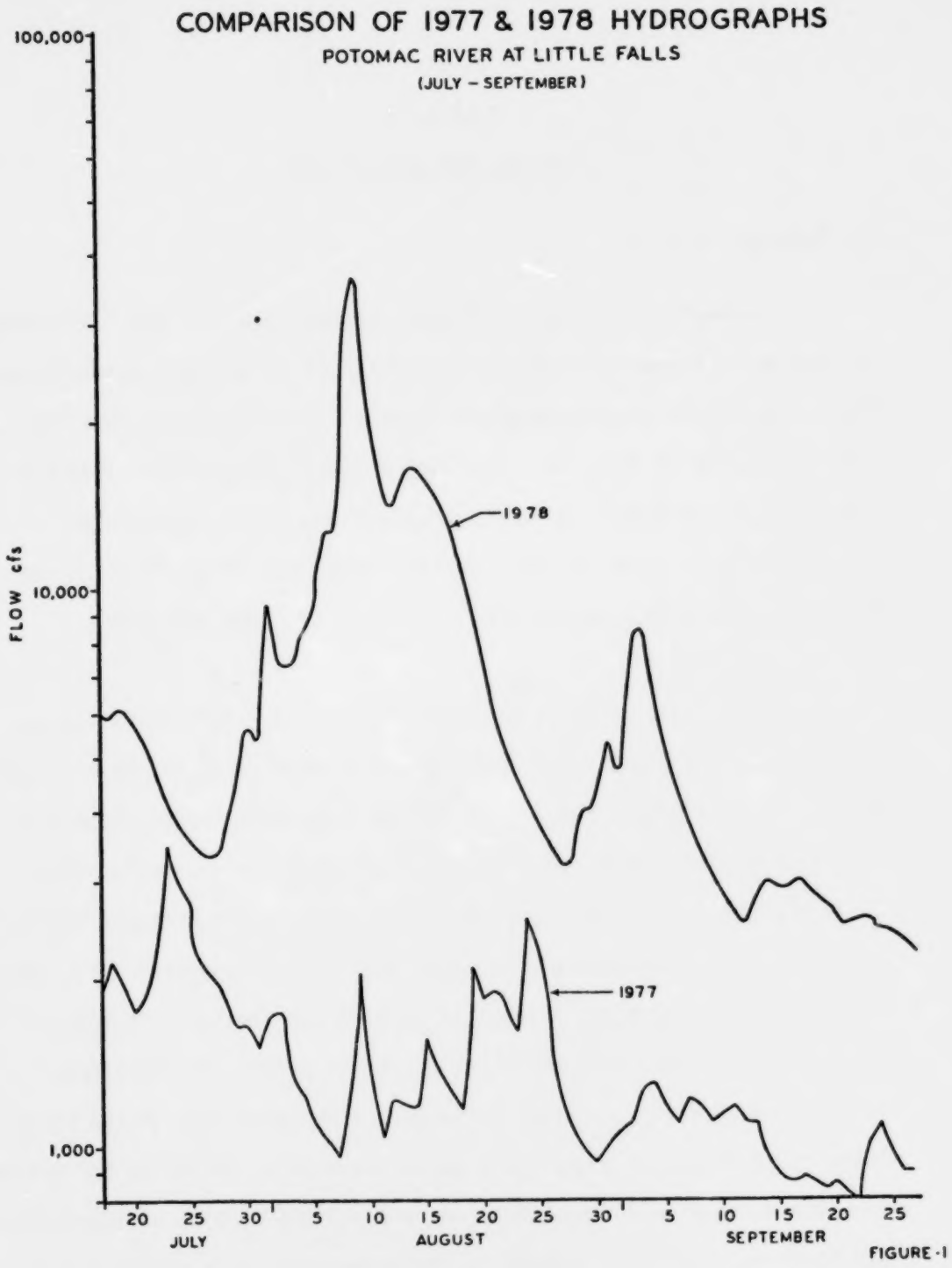

COMPARISON OF 1977 & 1978 HYDROGRAPHS
POTOMAC RIVER AT LITTLE FALLS
(JULY – SEPTEMBER)
100,000
10,000
1,000
FLOW cfs
1978
1977
20
25
30
5
10
15
20
25
30
5
10
15
20
25
JULY
AUGUST
SEPTEMBER

FIGURE-1

WATER TEMPERATURE, RAINFALL, & FLOW CHARACTERISTICS
FOR THE 1977 POTOMAC MONITORING PERIOD

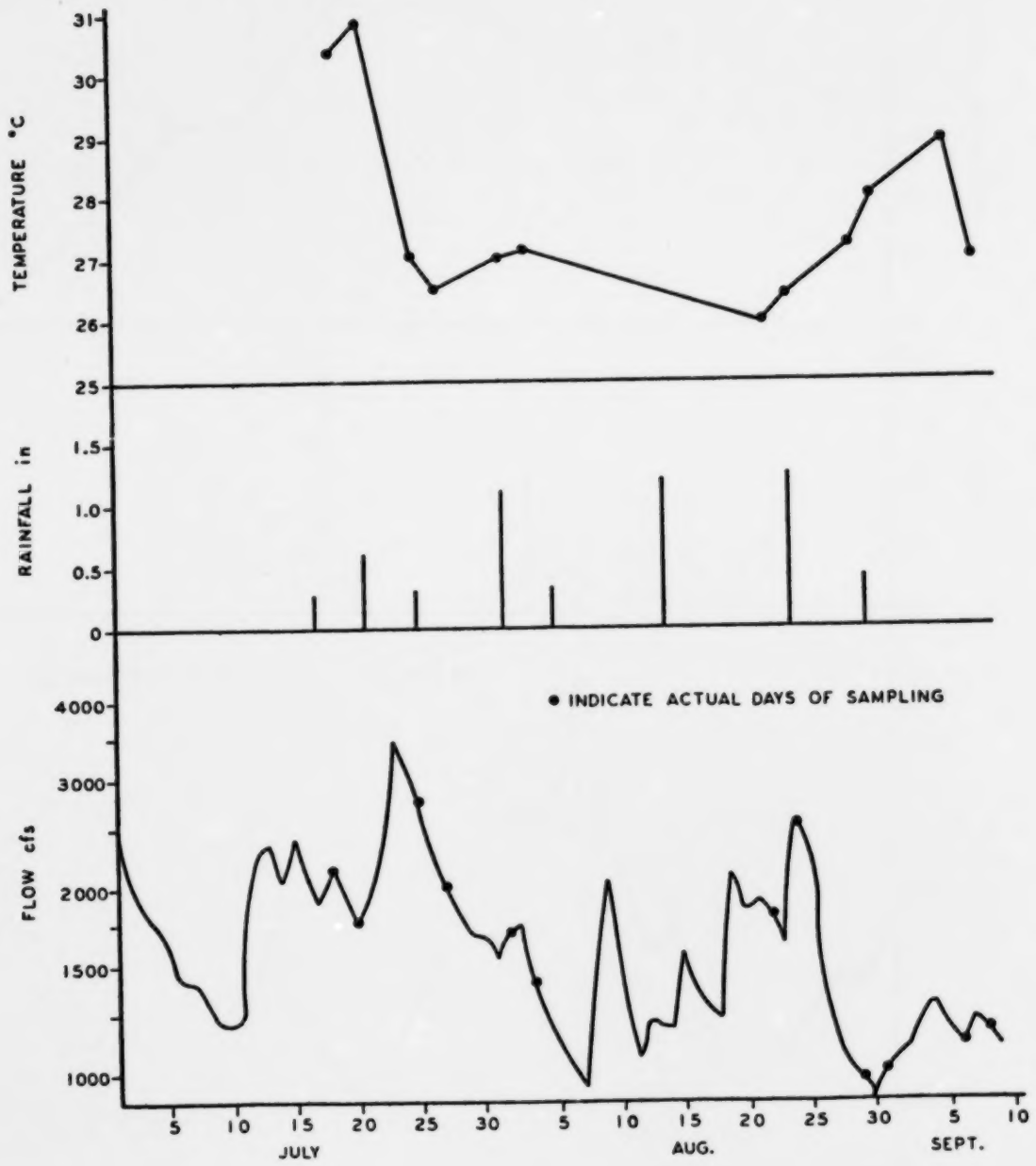


FIGURE-2

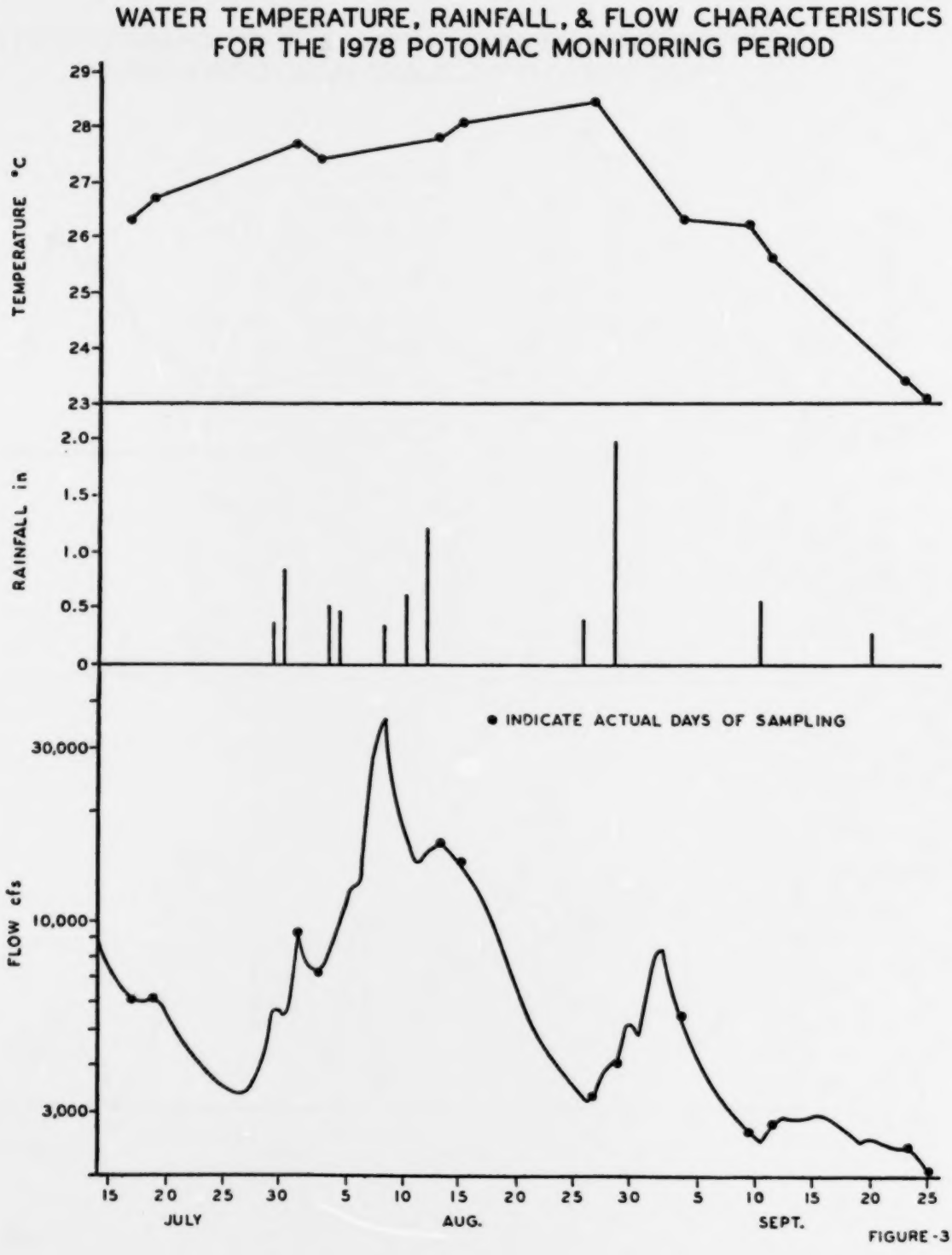

WATER TEMPERATURE, RAINFALL, & FLOW CHARACTERISTICS
FOR THE 1978 POTOMAC MONITORING PERIOD
TEMPERATURE °C
29
28
27
26
25
24
23
RAINFALL in
2.0
1.5
1.0
0.5
0
● INDICATE ACTUAL DAYS OF SAMPLING
FLOW cfs
30,000
10,000
3,000
15 20 25 30 5 10 15 20 25 30 5 10 15 20 25
JULY
AUG.
SEPT.

FIGURE-3

widespread as shown by the hydrograph responses and may have a lesser impact on water quality.

3. The average water temperature during the 1978 study period was 26.5°C, approximately 1° less than the average 1977 water temperature (see Figures 2 and 3). The daily minimum and maximum measured water temperatures were 22.9°C and 28.5°C (September 27 and August 28 respectively). Spatial variations in temperature over a given sampling run were normally less than 2°C with no consistent pattern evident.

4. There appeared to be a very strong relationship (inverse) between flow and Secchi Disk in the critical algae producing reach of the upper estuary during mid-August, 1978 when peak flows (10,000 - 35,000 cfs) occurred, but not during the remainder of the study period. Minimum Secchi Disk depths at that time ranged between 10" and 14".

5. A comparison of the Secchi Disk data collected during the July periods in 1977 and 1978, when chlorophyll levels were relatively low and minimal interference would be expected, indicated that comparable conditions with respect to light transmission occurred in the critical algal production reach of the estuary. Secchi Disk readings for both years averaged about 22 inches (except when high flows prevailed) as can be seen in Figure 4.

6. Examining all of the Secchi Disk data for 1977 and 1978 as a function of chlorophyll, which is presented in Figure 5, does not suggest a significantly different light regime between the two years. Unfortunately, no chlorophyll data was available during the peak flow sampling runs when pronounced differences would be expected. Although 1978 flows were generally much higher than 1977, there was only about a 2" difference

COMPARISON OF SELECTED 1977 & 1978 SECCHI DISK DATA

POTOMAC ESTUARY BETWEEN PISCATAWAY & POSSUM Pt.

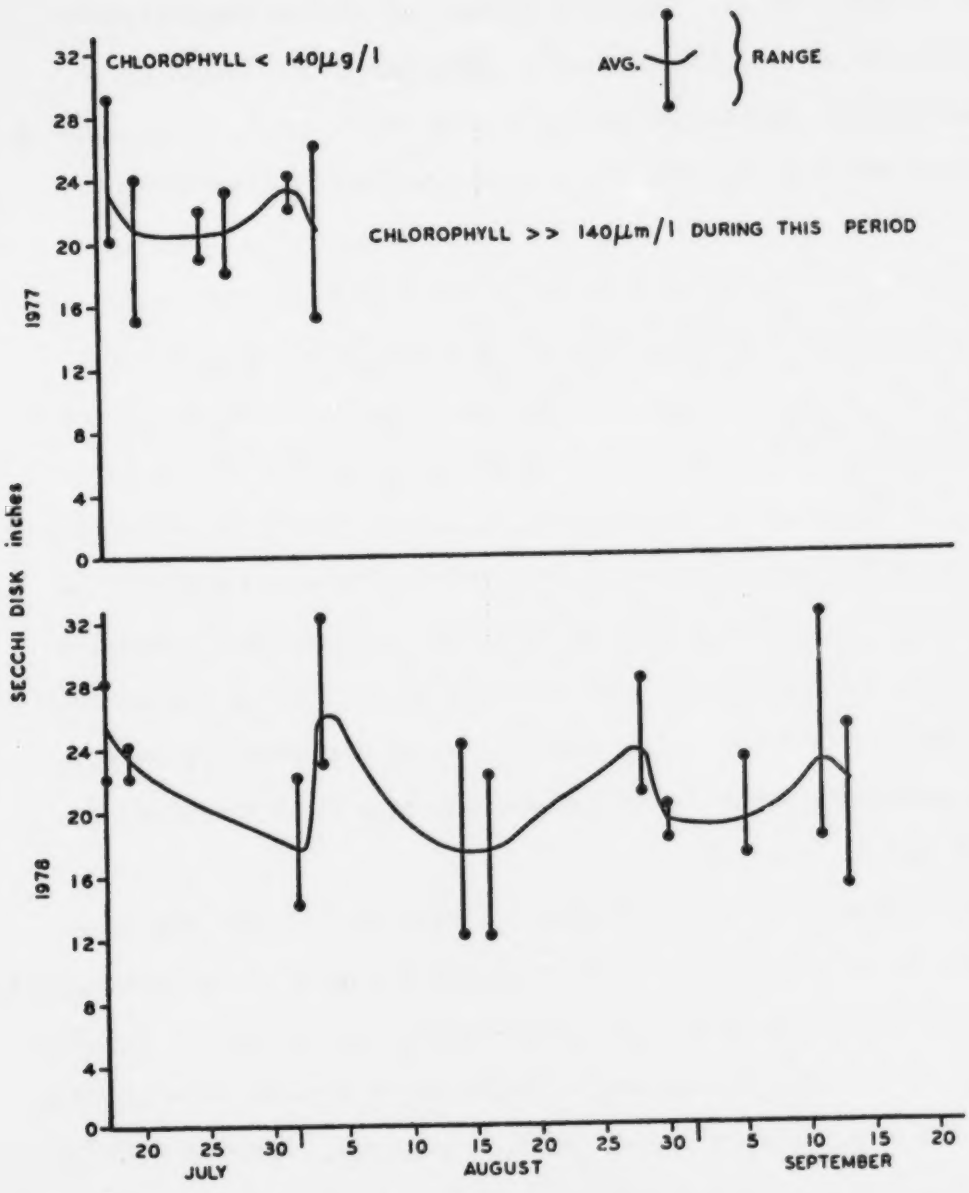


FIGURE-4

SECCHI DISK vs CHLOROPHYLL a
FRESHWATER PORTION OF POTOMAC ESTUARY
(1977 AND 1978 DATA)

• 1977
× 1978

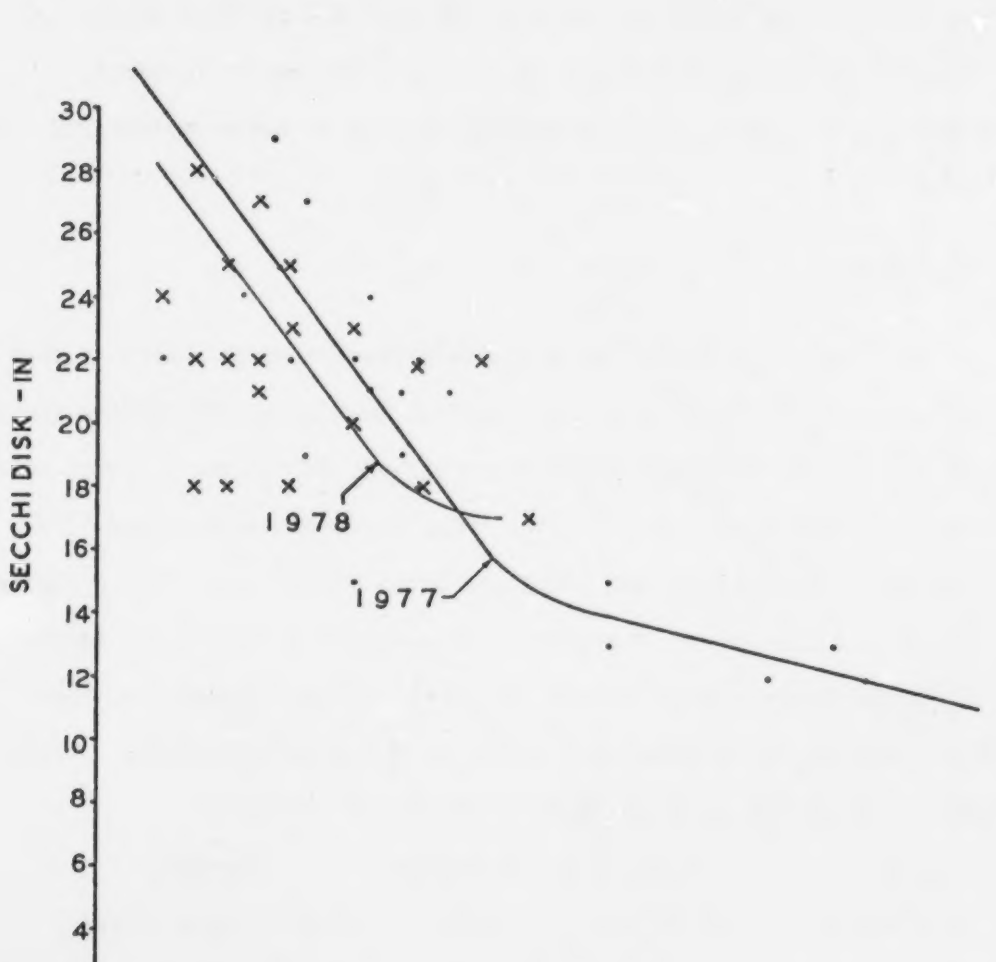


FIGURE - 5

in Secchi depth for the lower half of the chlorophyll spectrum.

7. The turbidity levels in the Upper Potomac were also strongly influenced by river flow as shown in Figure 6. During relatively low flows (4,000 cfs) the turbidity was very constant ranging between 5 and 8 NTU. However, the high flow condition (15,000 cfs) exhibited turbidity values ranging from 28 NTU at Chain Bridge to 7 NTU at Smith Point. It is interesting to note that there was a steady decline in turbidity throughout this 45 mile reach presumably because of sedimentation and dilution.

B. Nutrients

To facilitate the evaluation and interpretation of the nutrient data as well as other selected data obtained from this study, the entire study period was divided into much shorter sub-periods which were as comparable as possible with respect to (1) river flow, (2) water temperature, (3) occurrence of storm events and (4) algal bloom proportions. The grouping of data of similar origin strengthens the conclusions concerning spatial and temporal trends, the effects of one parameter on another, and the basic transport, transformation and fate of different pollutants. Those periods selected for purposes of this report are as follows:

Time	Flow	Temperature	Comments
July 17-19	6,000 cfs	25.5°C	Dry - little algae
August 1-3	8,000 cfs	27.5°C	Between storm events
August 14-16	15,500 cfs	28°C	Follows major storms
September 11	2,700 cfs	26°C	Dry - algae increasing
September 25-27	2,300 cfs	23°C	Dry - maximum bloom period

POTOMAC ESTUARY WATER QUALITY DATA

TIME PERIOD:
— AUGUST 14-16, 1978 (15,000 cfs)
— AUGUST 28-30, 1978 (4,000 cfs)

PARAMETERS: TURBIDITY

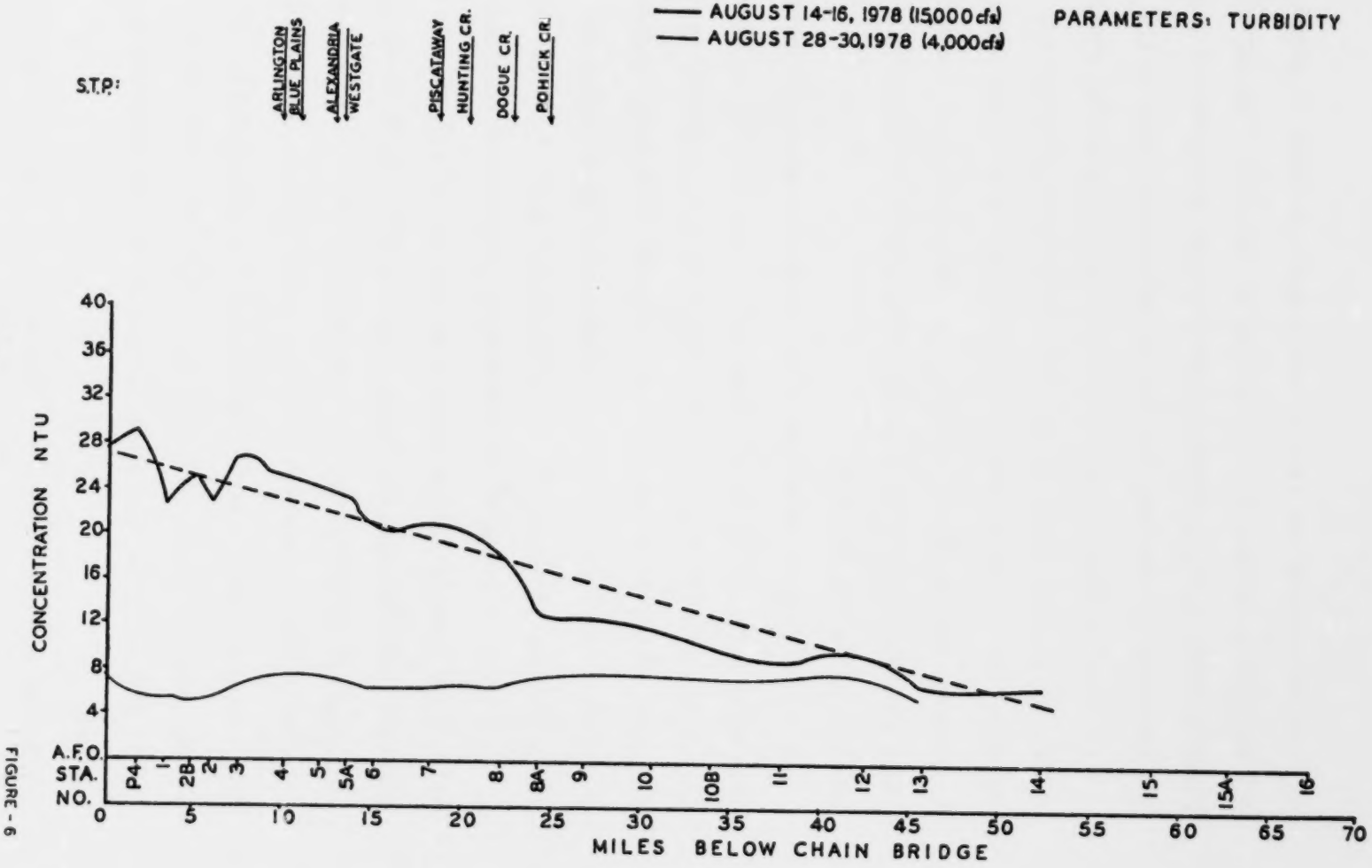


FIGURE - 6

Spatial profiles for five different measured forms of phosphorus are depicted in Figures 7 - 11 for each of the above time periods. Liekwise, five nitrogen fractions are included in Figures 12 - 16. The following observations can be made relative to these data:

1. Distributions of soluble Pi (as PO_4), soluble TPO_4 and TPO_4 are quite similar during each of the five sub-periods investigated. Except for the high flow period (August 14-16), when the Chain Bridge input appeared to dominate the phosphorus trend in the upper portion of the estuary, these phosphorus fractions also exhibited similar distributions from one time period to the next.

2. Filtered inorganic (reactive) phosphorus generally increased from about 0.05 mg/l to 0.15 - 0.20 mg/l in the vicinity of Blue Plains. The maximum concentration in this area, 0.35 mg/l, occurred in late September when river flows were low. Farther downstream, concentrations declined to the 0.05 to 0.10 mg/l range, which approximates the classical limiting value of phosphorus for algal growth (i.e. 0.03 mg/l as P).

3. There is a consistent and dramatic increase in filtered Pi levels below river mile 30 (Indian Head) which are not attributable to external sources. Releases from the bottom sediment which could be strongly influenced by salinity, DO, iron, pH and other factors is a suspected (currently being investigated by USGS) cause of these elevated Pi levels which often exceed 0.3 mg/l. Considering the fact that the estuary's volume increases substantially in this lower reach, the changes in actual mass would be more appreciable than the concentration profiles indicate.

4. As mentioned previously, the total phosphorus (both filtered

POTOMAC ESTUARY WATER QUALITY DATA

FLOW: 6000 cfs
TEMP.: 26.5°C
TIDE : LWS

TIME PERIOD: JULY 17-19, 1978

PARAMETERS: -----Pi (filt.)
——— Porg (filt.) } AS PO4
-·-·-PART P

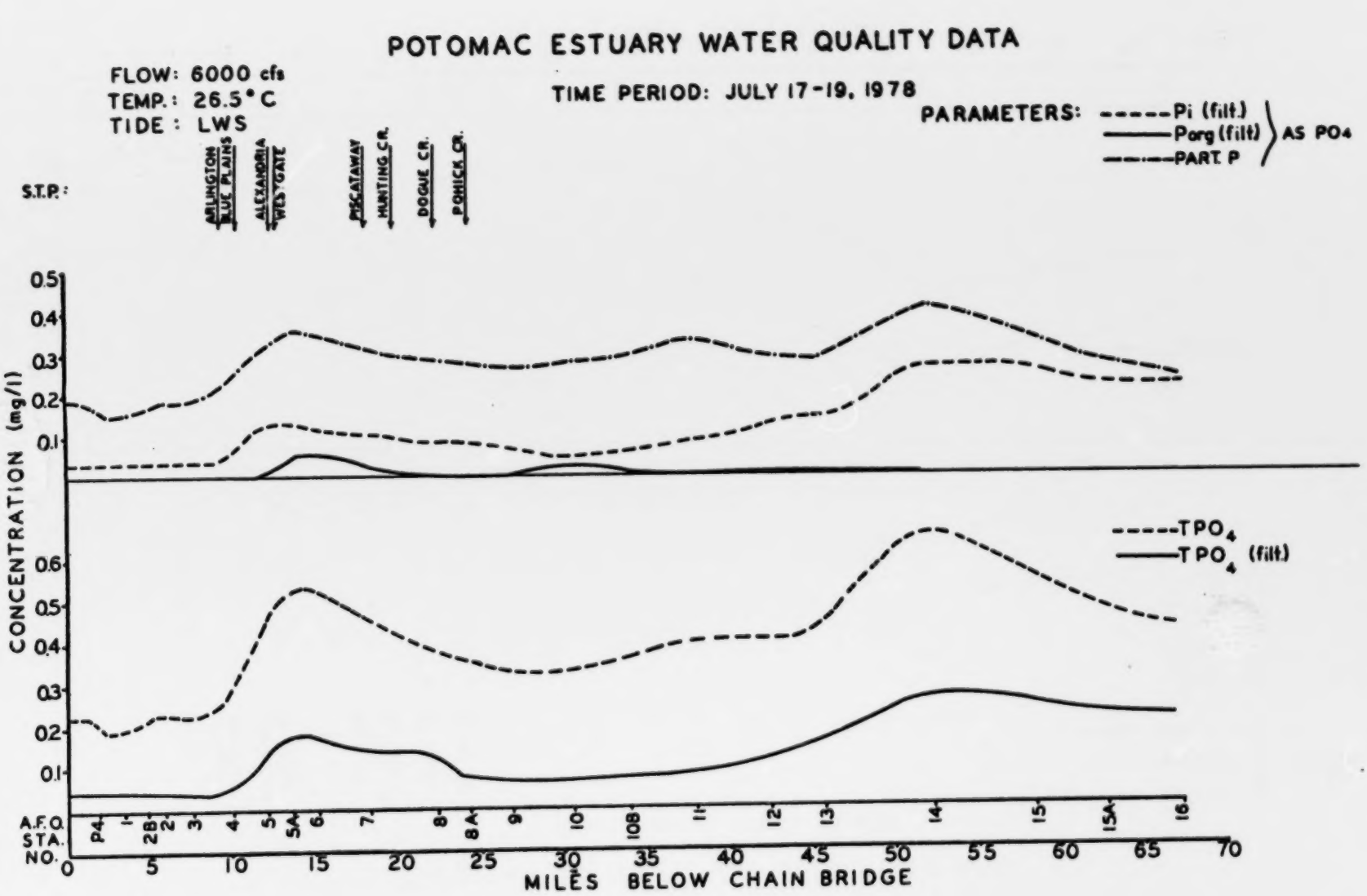


FIGURE-7

POTOMAC ESTUARY WATER QUALITY DATA

FLOW : 8,000 cfs
TEMP. : 27.5°C
TIDE : LWS

TIME PERIOD: AUGUST 1-3, 1978

S.T.P.: ARLINGTON, ALLIE PLAINS, ALEXANDRIA, WESTGATE, PISCATAWAY, HUNTING C.R., DOGUE CR., POHICK C.R.

PARAMETERS: ---- Pi (filt.), —— Porg (filt.), -·-·- PART. P } AS PO4

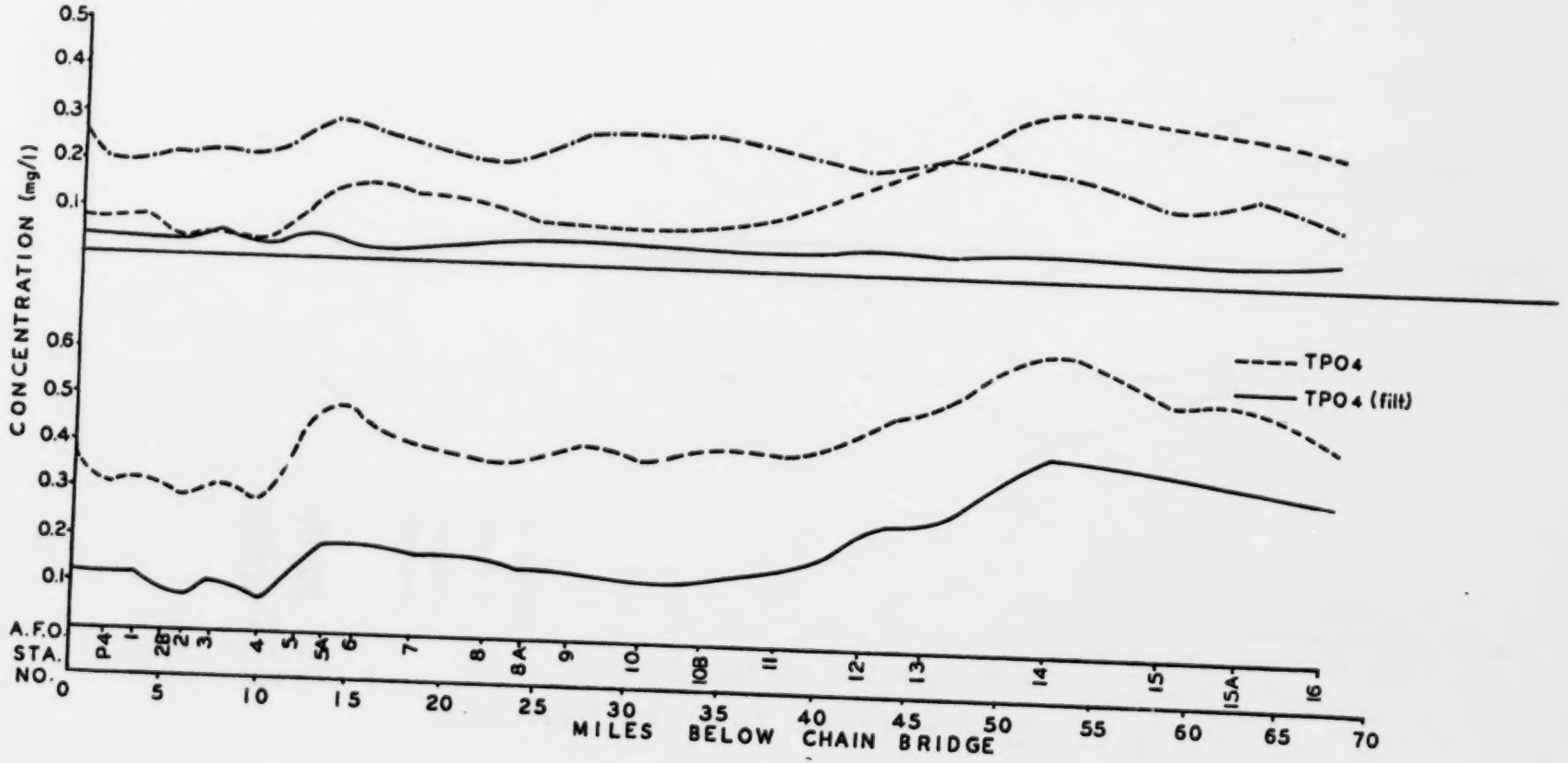


FIGURE - 8

POTOMAC ESTUARY WATER QUALITY DATA

FLOW : 15,500 cfs
TEMP. : 28°C
TIDE : HWS & LWS

TIME PERIOD: AUGUST 14-16, 1978

PARAMETERS: ---- P_i (filt.)
—— P_{org} (filt.)
-·-·- PART. P
} AS PO_4

S.T.P.: ARLINGTON, BLUE PLAINS, ALEXANDRIA, WESTGATE, PISCATAWAY, HUNTING CR., DOGUE CR., POHICK CR.

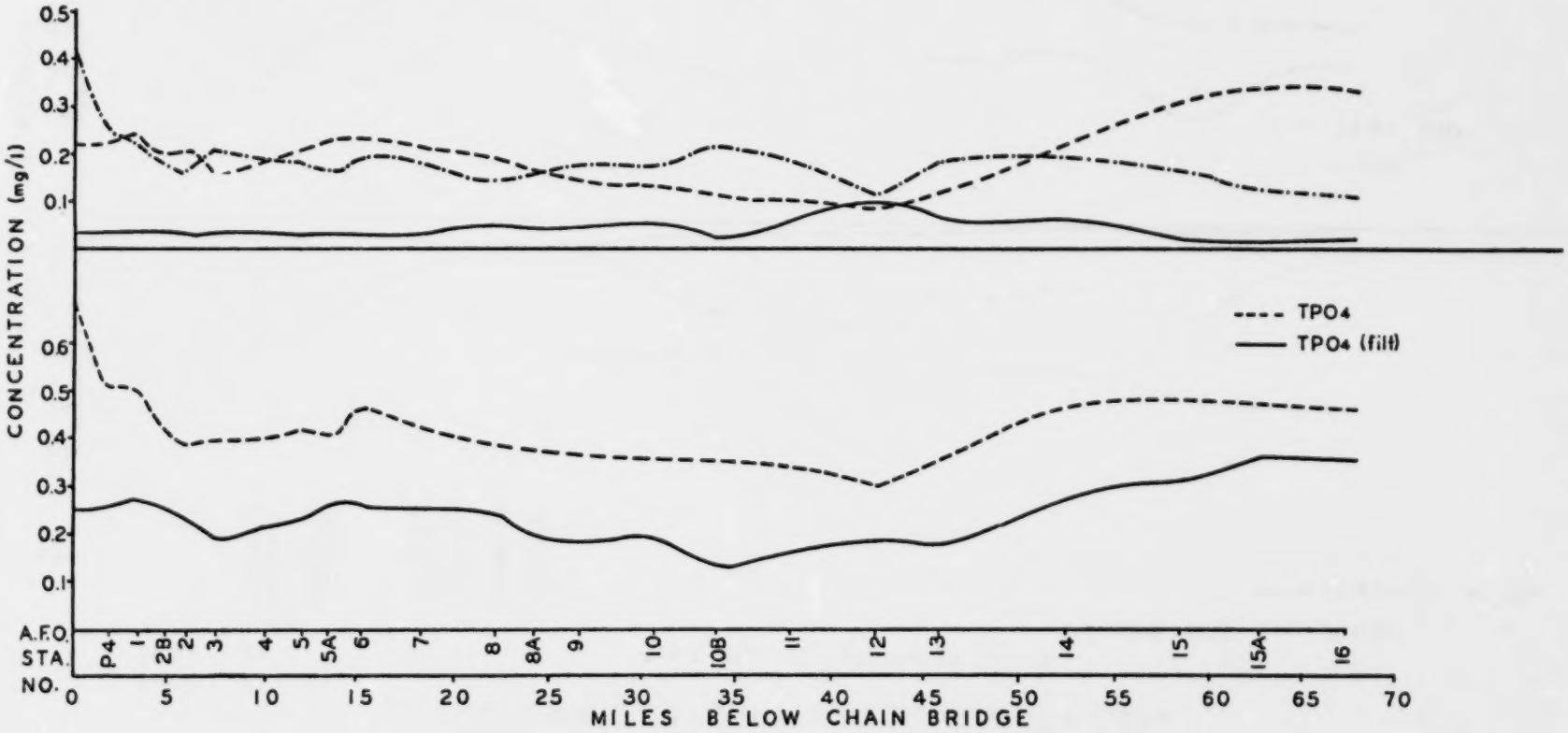


FIGURE - 9

POTOMAC ESTUARY WATER QUALITY DATA

FLOW: 2700 cfs
TEMP.: 26°C
TIDE: HWS

TIME PERIOD: SEPTEMBER 11, 1978

PARAMETERS: ----- Pi (filt.)
——— Porg (filt.)
-·-·- PART. P
} AS PO4

S.T.P.: ARLINGTON, BLUE PLAINS, ALEXANDRIA, WESTGATE, PISCATAWAY, HUNTING CR., DOGUE CR., POHICK CR.

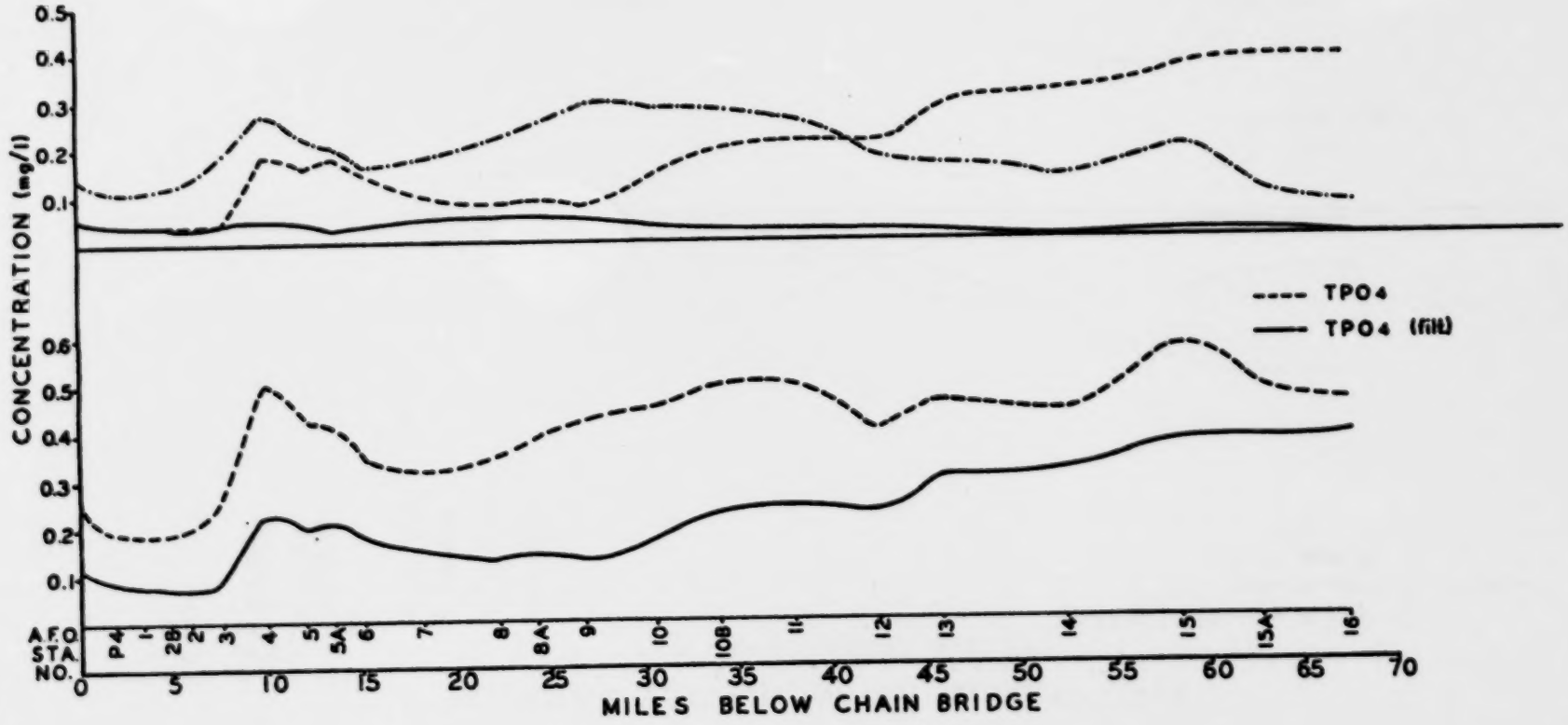


FIGURE-10

POTOMAC ESTUARY WATER QUALITY DATA

FLOW : 2300 cfs
TEMP. : 23°C
TIDE : HWS

TIME PERIOD: SEPTEMBER 25-27, 1978

PARAMETERS: ---- Pi (filt.)
—— Porg (filt.)
-·-· PART. P
} AS PO4

S.T.P.: ARLINGTON BLUE PLAINS, ALEXANDRIA WESTGATE, PISCATAWAY, HUNTING CR., DOGUE CR., POHICK CR.

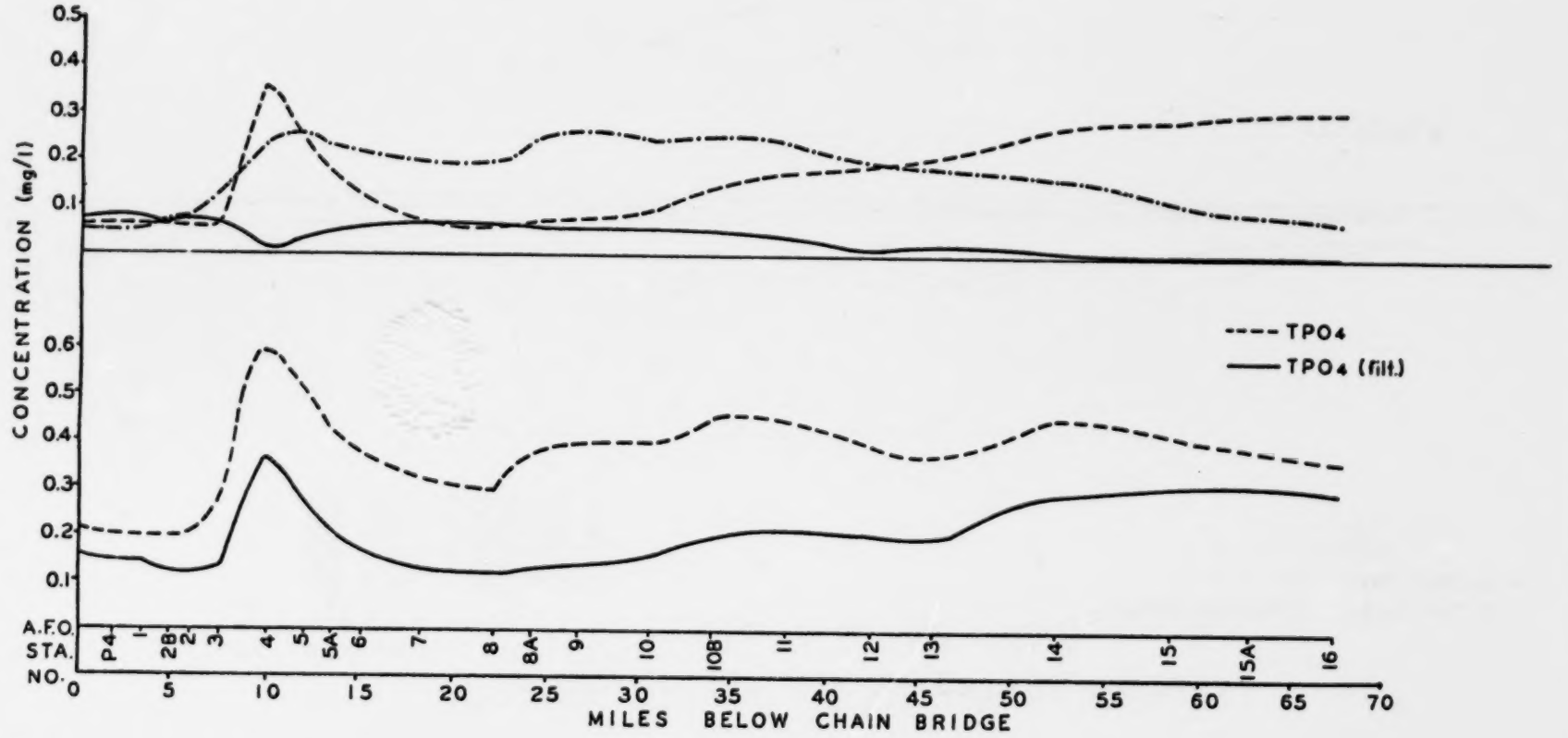


FIGURE-11

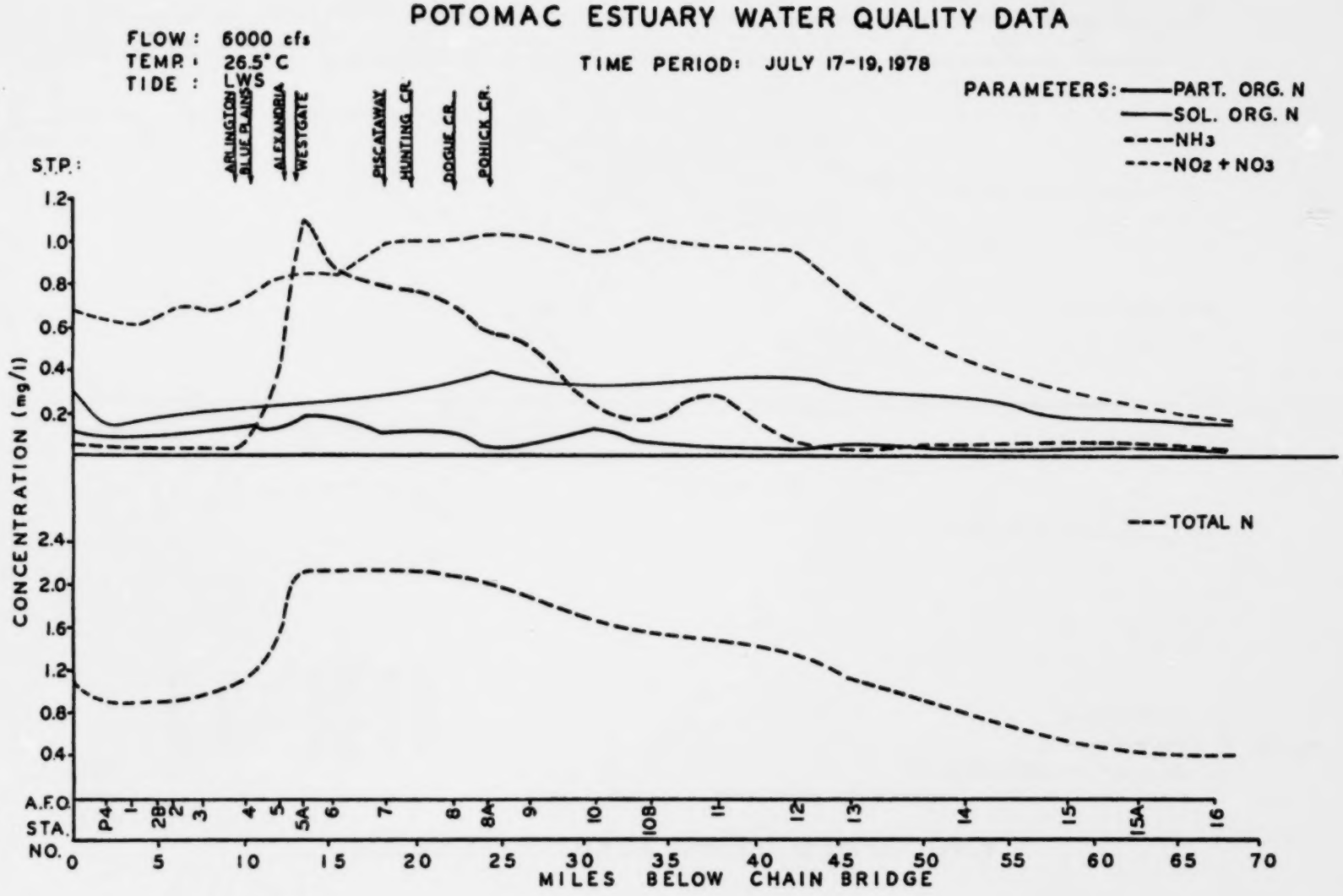

POTOMAC ESTUARY WATER QUALITY DATA
FLOW : 6000 cfs
TEMP. : 26.5° C
TIDE : LWS
TIME PERIOD: JULY 17-19, 1978
PARAMETERS: ——PART. ORG. N
——SOL. ORG. N
----NH3
----NO2 + NO3
---TOTAL N
ARLINGTON
BLUE PLAINS
ALEXANDRIA
WESTGATE
PISCATAWAY
HUNTING CR.
DOGUE CR.
POHICK CR.
STP.
CONCENTRATION (mg/l)
1.2
1.0
0.8
0.6
0.4
0.2
2.4
2.0
1.6
1.2
0.8
0.4
A.F.O. STA. NO.
P4
1
2B
2
3
4
5
5A
6
7
8
8A
9
10
10B
11
12
13
14
15
15A
16
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
MILES BELOW CHAIN BRIDGE

FIGURE-12

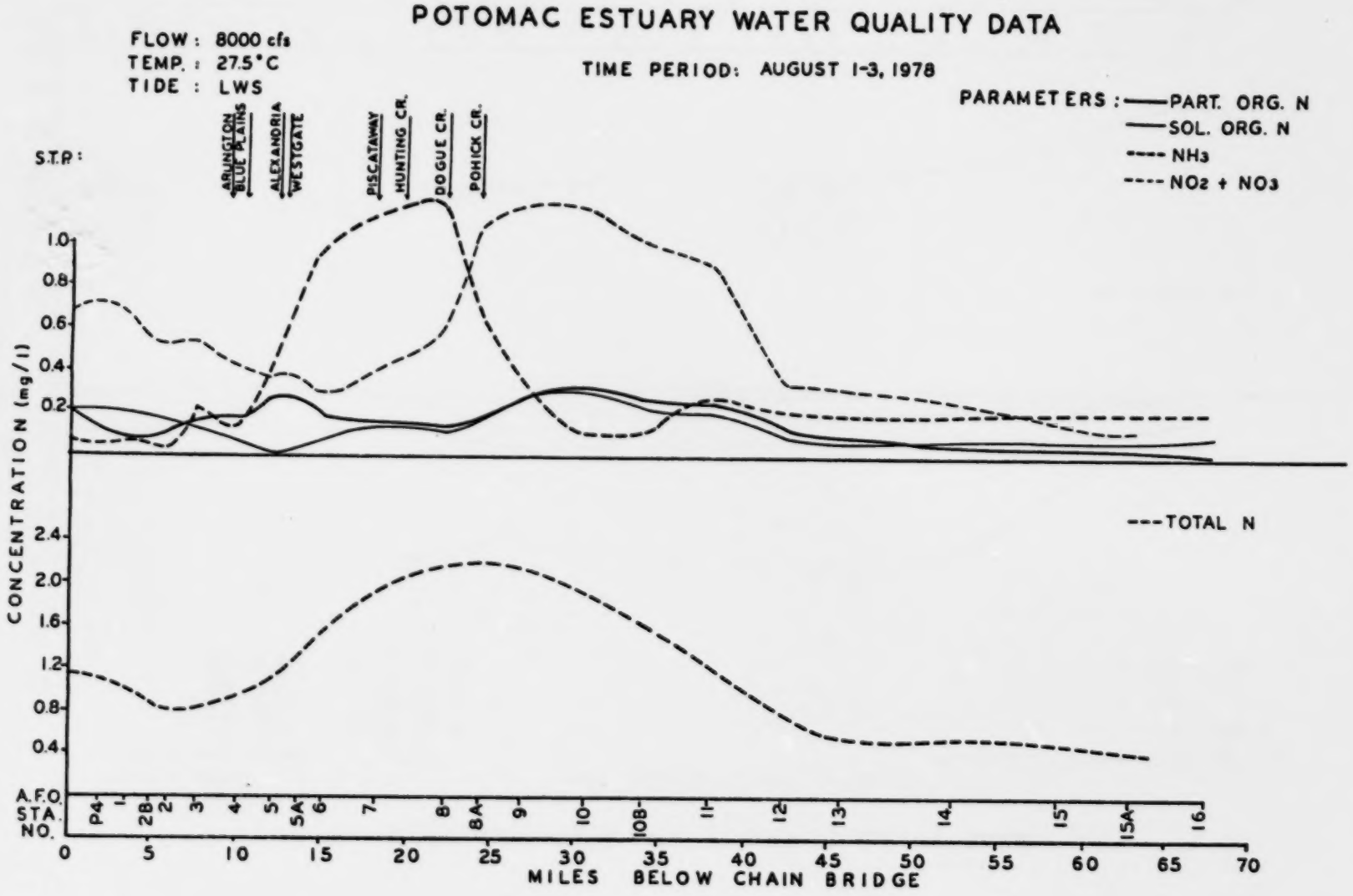

POTOMAC ESTUARY WATER QUALITY DATA
FLOW : 8000 cfs
TEMP. : 27.5°C
TIDE : LWS
TIME PERIOD: AUGUST 1-3, 1978
PARAMETERS :
PART. ORG. N
SOL. ORG. N
NH3
NO2 + NO3
TOTAL N
S.T.P.:
ARLINGTON BLUE PLAINS
ALEXANDRIA WESTGATE
PISCATAWAY
HUNTING CR.
DOGUE CR.
POHICK CR.
CONCENTRATION (mg/l)
1.0
0.8
0.6
0.4
0.2
2.4
2.0
1.6
1.2
0.8
0.4
A.F.O. STA. NO.
P4
1
2B
2
3
4
5
5A
6
7
8
8A
9
10
10B
11
12
13
14
15
15A
16
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
MILES BELOW CHAIN BRIDGE

FIGURE-13

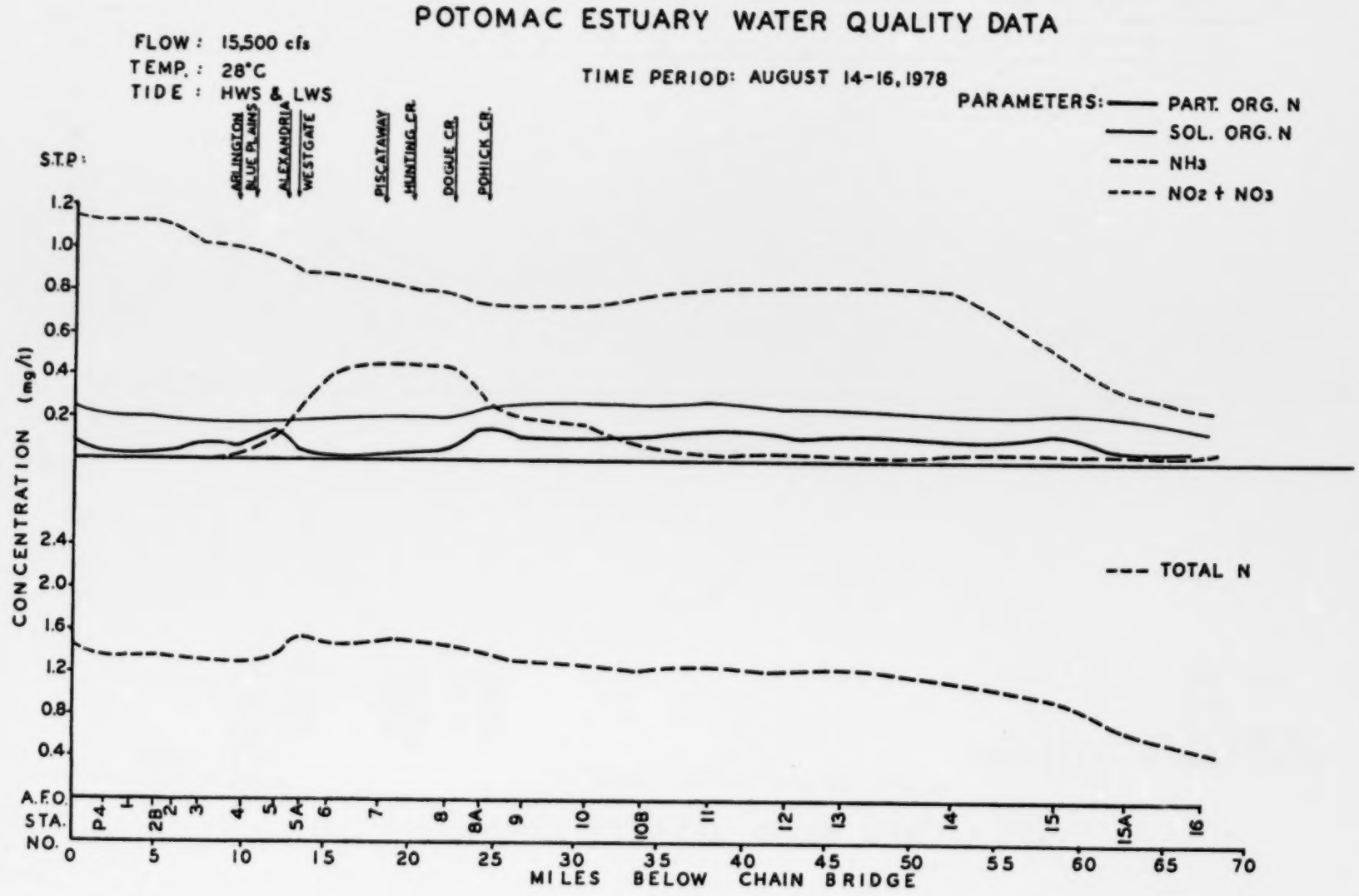

POTOMAC ESTUARY WATER QUALITY DATA
FLOW : 15,500 cfs
TEMP. : 28°C
TIDE : HWS & LWS
TIME PERIOD: AUGUST 14-16, 1978
PARAMETERS:
PART. ORG. N
SOL. ORG. N
NH3
NO2 + NO3
TOTAL N
S.T.P.:
ARLINGTON BLUE PLAINS
ALEXANDRIA WESTGATE
PISCATAWAY
HUNTING CR.
DOGUE CR.
POHICK CR.
CONCENTRATION (mg/l)
1.2
1.0
0.8
0.6
0.4
0.2
2.4
2.0
1.6
1.2
0.8
0.4
A.F.O. STA. NO.
P4
1
2B
2
3
4
5
5A
6
7
8
8A
9
10
10B
11
12
13
14
15
15A
16
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
MILES BELOW CHAIN BRIDGE

FIGURE-14

POTOMAC ESTUARY WATER QUALITY DATA

FLOW : 2700 cfs
TEMP. : 26°C
TIDE : HWS

TIME PERIOD: SEPTEMBER 11, 1978

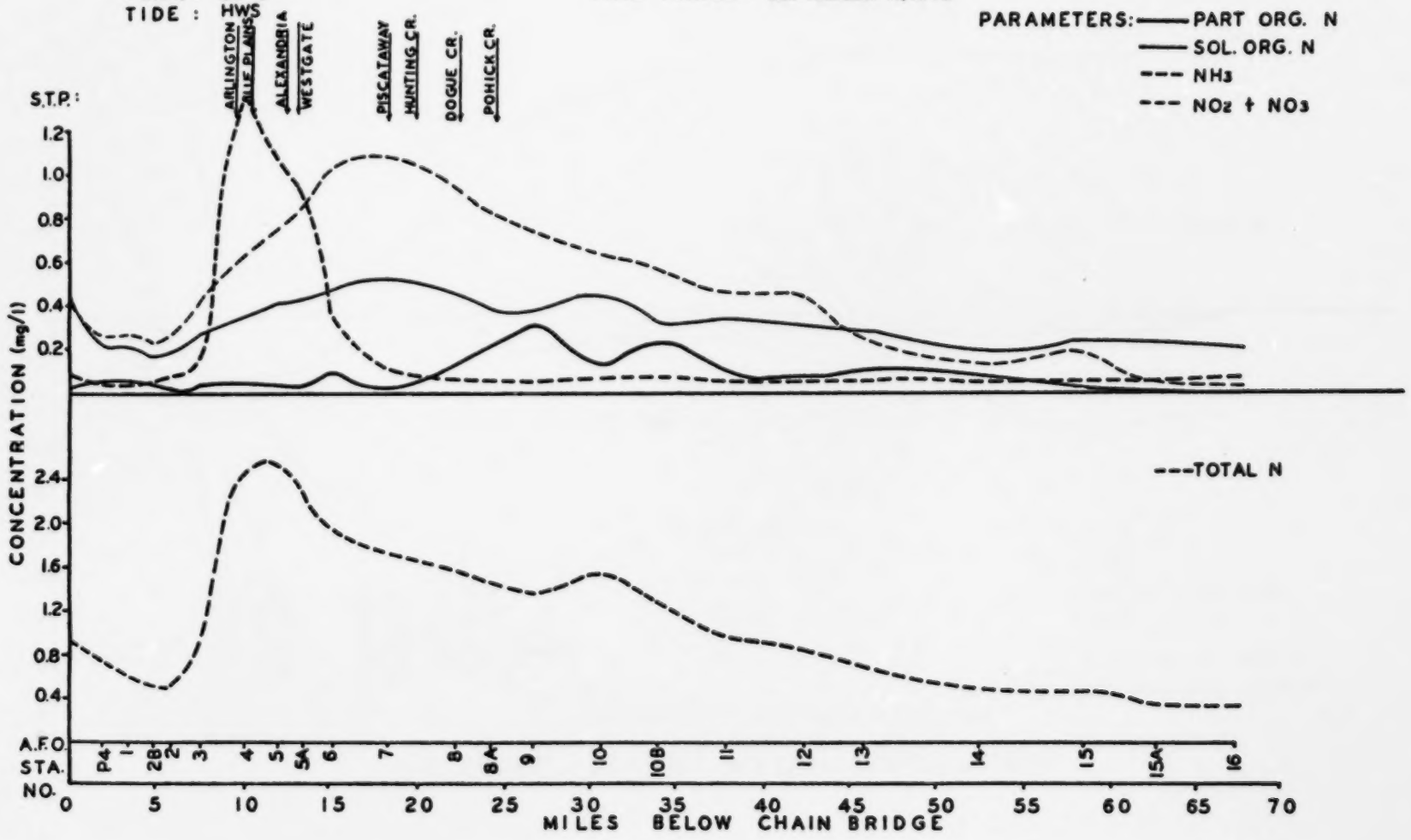


FIGURE-15

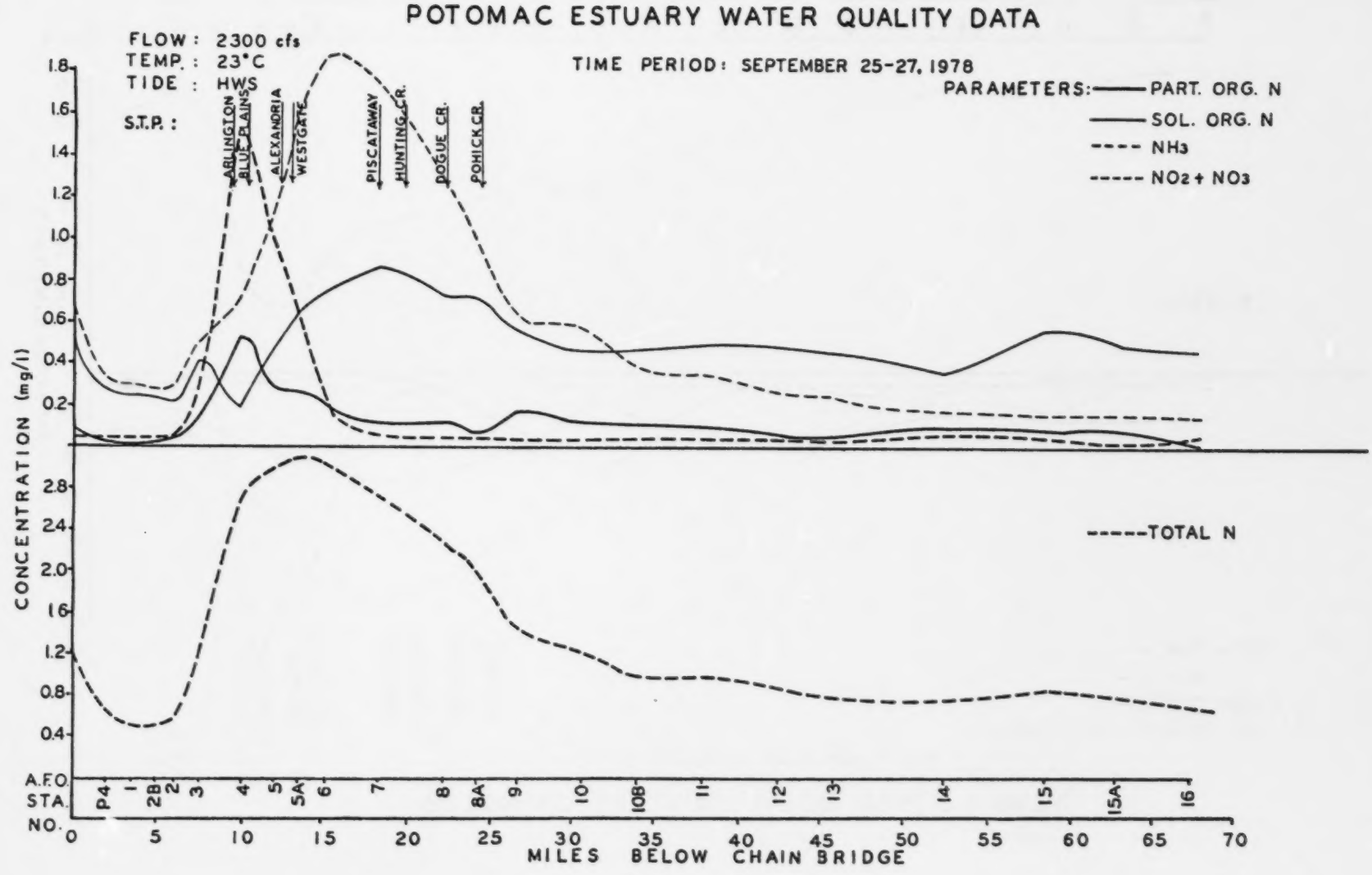

POTOMAC ESTUARY WATER QUALITY DATA
FLOW : 2300 cfs
TEMP. : 23°C
TIDE : HWS
S.T.P. :
TIME PERIOD: SEPTEMBER 25-27, 1978
PARAMETERS:
PART. ORG. N
SOL. ORG. N
NH3
NO2 + NO3
TOTAL N
ARLINGTON
BLUE PLAINS
ALEXANDRIA
WESTGATE
PISCATAWAY
HUNTING CR.
DOGUE CR.
POHICK CR.
CONCENTRATION (mg/l)
A.F.O. STA. NO.
P4 1 2B 2 3 4 5 5A 6 7 8 8A 9 10 10B 11 12 13 14 15 15A 16
MILES BELOW CHAIN BRIDGE

FIGURE-16

and unfiltered) distributions were similar to Pi in that peak concentrations occurred near Blue Plains (≈ 0.5 mg/l - TPO_4 and ≈ 0.2 mg/l - TPO_4 filtered) and in the lower 15 miles of the study area. Since filtered organic P remains relatively low and constant throughout, it is reasonable to assume that these down river TPO_4 peaks largely reflect the erratic behavior of Pi, generally the predominant form of phosphorus.

5. In the vicinity of Blue Plains approximately 1/2 of the total phosphorus is in the particulate form possibly because of a significant adsorptive reaction. This ratio increases somewhat in the algae producing reach because of biological uptake of soluble P and decreases in the lower 15 miles where the salinity influence is greatest.

6. During the four lower flow sub-periods there appeared to be a significant amount of nitrification occurring as evidenced by the NH_3 and NO_2 + NO_3 profiles. The NH_3 fraction generally peaked in the vicinity of Blue Plains at about 1.1 - 1.5 mg/l and then declined fairly rapidly to background levels. This decline was accompanied by dramatic increases in NO_2 + NO_3 also in excess of 1.0 mg/l. Distribution of these two forms of nitrogen were much different, however, during the high flow sub-period. The effects of dilution in the case of NH_3 and the dominance of the NO_2 + NO_3 entering the Potomac as a result of the high flows are vividly demonstrated by the August 14-16 profiles (Figure 14). As can be seen they greatly masked the nitrification process.

7. The organic nitrogen in the particulate form is relatively low throughout the Potomac with the bulk of the concentration values being less than 0.3 mg/l. Peak concentrations were observed in the vicinity of Blue Plains and in the algae producing area between Gunston Cove and

Possum Point. These low values probably reflect the lack of a major algae bloom. It is interesting to note that particulate organic nitrogen was extremely low (i.e. <0.2 mg/l) even during the high flow sub-period when suspended sediment loads should be at a maximum.

8. Soluble organic nitrogen was somewhat higher but no more erratic than the particulate form. Concentrations were consistently less than 0.5 mg/l regardless of time or location. The two highest values, 0.8 and 0.5 mg/l did, however, occur in the vicinity of Piscataway Creek for unexplained reasons.

9. When eliminating the unusual distribution associated with the high flow sub-period, it can readily be seen that total nitrogen is diluted (in contrast to phosphorus) in the lower 45 - 50 miles of the study area. Concentrations diminish in this reach from over 2.0 mg/l to about 0.4 mg/l.

10. Historical water quality data indicates that there is a distinct relationship between the concentration of a pollutant in Blue Plains effluent and the maximum concentration of that pollutant in the main channel of the Potomac Estuary. Moreover, the estuary's response to a load input is also somewhat affected by inflow rates. This data is presented in Table 4.

Total N concentrations from Blue Plains average about 15 mg/l. Maximum river concentrations ranged from about 4.0 mg/l at low flow conditions (1,000 cfs) to about 2.0 mg/l at high flow conditions (10,000 cfs). A similar situation occurs with NH_3 except its non-conservativeness produces concentrations which are about 1/2 those for total nitrogen.

The dramatic reduction in the Blue Plains phosphorus concentrations

TABLE 4

Relationship Between Blue Plains' Nutrient Inputs
and Maximum Concentration Response in Potomac Estuary

Time Period	Blue Plains Effluent							Max. Conc. - Potomac			
	Flow (cfs)	Temp °C	Flow mgd	TN	NH_3	TPO_4	Pi	TN	NH_3	TPO_4	Pi
				←----- mg/l -----→				←----- mg/l -----→			
August 12-14, 1969	8,000	26	273	15	10	15	10	3.0-3.5	1.0-1.5	1.5-2.0	1.0-1.5
July 22, 1970	4,800	26	271	14	10	20	12	3.0	1.0	1.5	1.0
July 17-August 3, 1978	7,000	27	326	15	13	4	2	2.0-2.5	1.0-1.3	0.5	0.15-0.2
August 14-16, 1978	15,000	28	360	15	13	4	2	1.5	0.6	0.45	0.2
August 19-22, 1968	2,500	28	260	15	10	20	-	3.0-3.5	1.5-2.0	2.0	E1.5
July 1, 1969	1,000	28.5	263	15	10	15	10	4.0-4.5	2.0	3.0	2.5
July-August, 1977	1,500	27	276	15	13	5	3	2.5-3.0	0.5-1.0	0.6	0.2-0.3
September 11-27, 1978	2,500	24.5	300	15	13	4	2	2.5-3.0	1.5	0.5	0.2-0.3

over the past 10 years is also vividly depicted in the estuary data. When TPO_4 effluent concentrations of 15 - 20 mg/l were experienced, maximum estuary responses of 1.5 - 3.0 mg/l were recorded. More current data, on the other hand, shows that an effluent concentration of about 4 mg/l produces a maximum response in the estuary of about 0.5 mg/l. In both instances there appears to be a dilution ratio of about 10 to 1.

11. As can be seen in Figure 17, similar trends occurred with respect to the ratio (ambient not cellular) of inorganic N to P (by atoms) except for the high flow period of August 14-16. Minimum values in the range of 40 - 80:1 occurred immediately downstream of Blue Plains. These ratios then increased to 115 - 135:1 at the start of the algae producing reach (RM 20 - 30) and finally underwent a very dramatic decrease in the remaining 35 miles of the study area. In every instance the N:P ratios were 7:1 or less at the stations fartherest downstream. During the high flow period, upper basin inputs dominated the pattern of N:P ratios which were relatively constant and always less than 68:1.

Comparing the 1977 and 1978 ambient N:P ratio data (Figure 17 and 18) reveals that their rate of spatial decline, or the tendency for nitrogen to rate limit algal biomass production, appears to be a function of the bloom size as measured by chlorophyll a.

12. It is not certain which, if any, nutrient is rate limiting algae growth during the summer of 1978. The available water data (ambient) is somewhat inconclusive on this point. There are locations within the critical zone where soluble inorganic PO_4 dips below 0.1 mg/l (0.03 mg/l as P), a level traditionally considered as potentially rate-limiting in

POTOMAC ESTUARY WATER QUALITY DATA

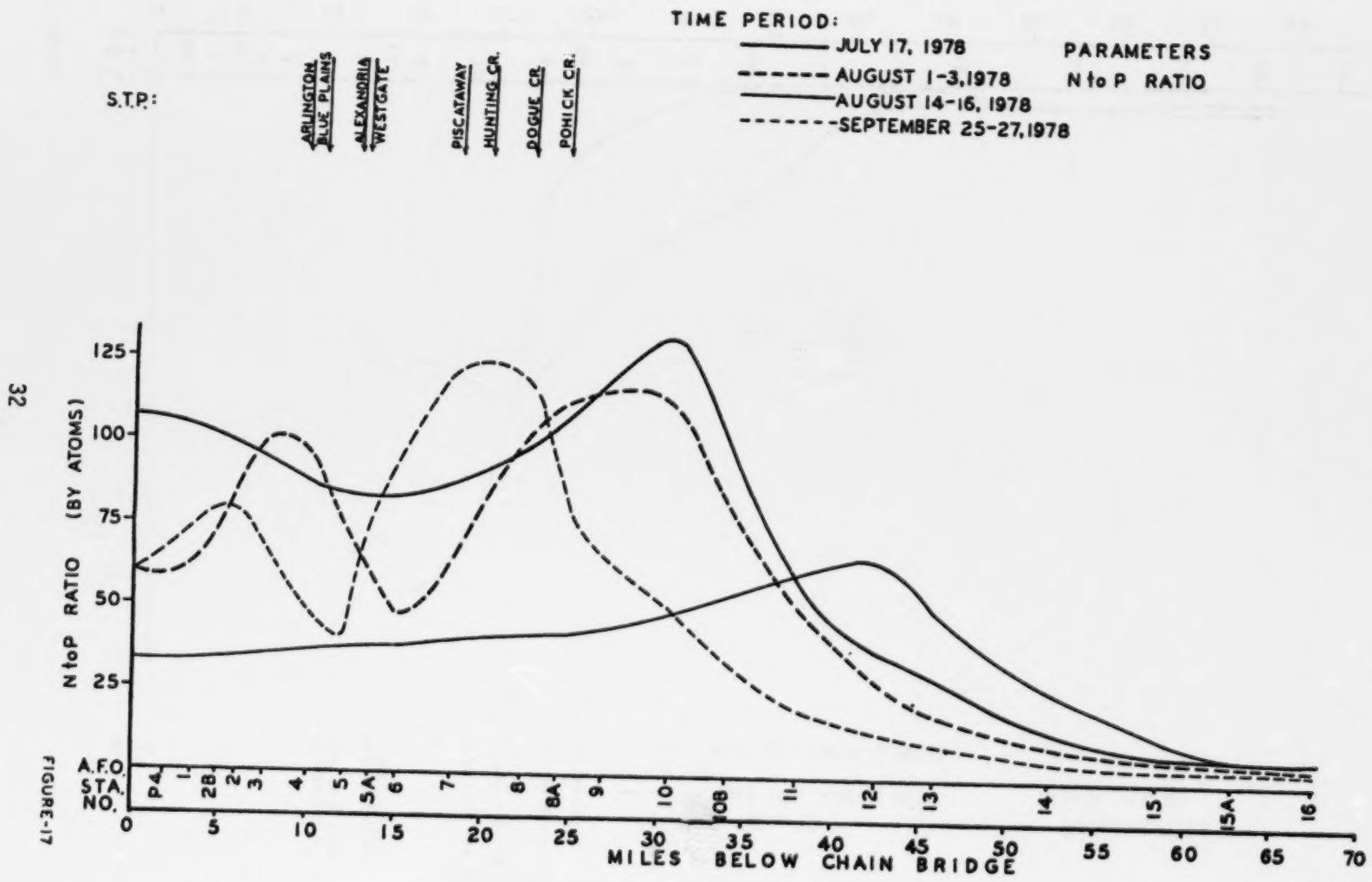


FIGURE-17

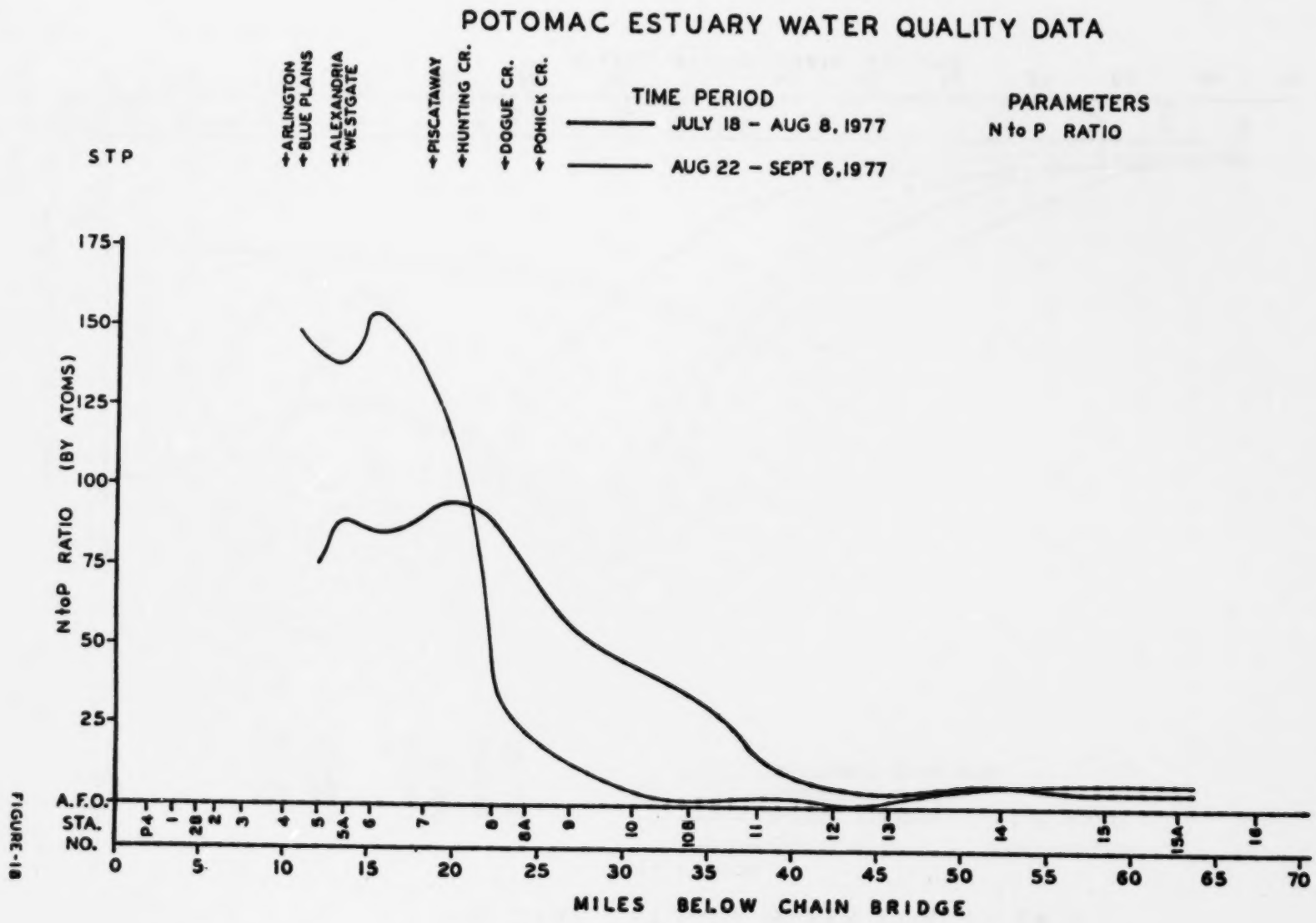

POTOMAC ESTUARY WATER QUALITY DATA
STP
ARLINGTON
BLUE PLAINS
ALEXANDRIA
WESTGATE
PISCATAWAY
HUNTING CR.
DOGUE CR.
POHICK CR.
TIME PERIOD
JULY 18 – AUG 8, 1977
AUG 22 – SEPT 6, 1977
PARAMETERS
N to P RATIO
N to P RATIO (BY ATOMS)
175
150
125
100
75
50
25
A.F.O. STA. NO.
P4 1 2B 2 3 4 5 5A 6 7 8 8A 9 10 10B 11 12 13 14 15 15A 16
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70
MILES BELOW CHAIN BRIDGE

FIGURE-18

certain environments. However, these low levels are very temporary since consistent increases are observed in other downstream portions of the critical zone that appear to be independent of algal growth conditions. In fact, this phenomenon, whose causes are still speculative, was also observed during the 1977 study period. Ratios of inorganic or available N:P would generally tend to indicate a surplus of nitrogen but one must recognize that these ratios were found to be highly variable at times and in areas where algal growth was at a maximum.

C. Algae

1. Chlorophyll a concentrations in the Potomac during 1978 were low in comparison to 1977 observations and had considerably less variability. They were unusual in that the maximum bloom condition occurred during late September when water temperatures were declining rapidly but river flows were at a minimum. As in 1977, the major algal activity occurred between river miles 25 and 40, as evidenced by peak chlorophyll values of 130 - 160 µg/l. Measured values through July and early August averaged about 50 µg/l in this critical reach and increased to about 80 µg/l by late August and early September.

2. Selected samples were collected in the critical zone during the course of this study for the purpose of identifying the quantitating ambient algae forms. Dr. James Allison, Maryland Water Resources Administration, with the assistance of Jeanine Fairchild, EPA/AFO, performed the visual microscopic analysis. During the July and August portion of the study period, approximately 60 percent of the algal

population consisted of diatoms. Of the remainder, only 14 percent was accounted for by blue-green forms of which none was dominant. The dominant diatom (80 percent of total) was Cyclotella. The chlorophyll a varied from about 20 to 100 µg/l with a mean of 50 µg/l. The total actual cell counts varied from ~~150 to 350~~ 7100-18900 per ml.

In the latter part of the study, when chlorophyll a was averaging about 100 µg/l, there was an abrupt change in the predominant algal species and the number of cells present. From September 11-28, diatoms comprised only about 14 percent of the population, although Cyclotella remained the dominant genus. Blue-green varieties, however, now comprised approximately 80 percent of the total population and 87 percent of the blue-green population was identified as Pseudanabaena catenata, by Drs. Allison and Sze (Georgetown University). Cell counts for this alga had risen to the 60,000 - 80,000 per ml range.

3. Pseudanabaena has a remarkable similarity to Oscillatoria, the predominant form of algae documented in the Potomac during 1977. Both are filamentous and can be described as being a "box car like" chain with each unit measuring only a few microns. Perhaps a misidentification was made in 1977 because of this similarity. It is interesting to note that this dominant form of algae was also tentatively identified as Schizothrix during September, 1978.

Pseudanabaena is benthic in origin and may have been initially cultivated in small or shallow embayments and then washed into the larger and deeper areas of the Potomac Estuary itself. The organism does not contain heterocysts and is probably not nitrogen fixing.

4. It is not certain why this bloom of Pseudanabaena proliferated the

way it did, when it did. As mentioned previously, there was no radical change in the nutrient regime immediately preceding the bloom nor was there clear evidence that one particular macro-nutrient was rate limiting. Other factors such as: (1) the grazing by zooplankton on competitive algal forms, (2) the rapidly declining hydrograph during the bloom period, (3) the availability of silicate for continued diatom predominance, (4) increased iron concentrations from Blue Plains and (5) light availability may have important implications and require further investigation.

5. A total of nineteen samples were collected and analyzed to determine the elemental composition of the phytoplankton population which, at the time of sampling (September 7-28), was primarily blue-green algae. The results are tabulated below:

Algal Composition Summary

	Mg C / µg Chloro	Mg N / µg Chloro	Mg PO_4 / µg Chloro
Range	.015-.027	.0035-.0086	.0010-.0029
Average	.021	.0054	.0020
Standard Deviation	.004	.0012	.0005

6. In addition to lab data, gross estimates of the amounts of organic carbon, nitrogen, and phosphorus within algal cells were also made using field data collected during the slack water runs. All of the available 1977-78 algal elemental composition analysis data are presented in Figures 19 to 21. It can be seen that the laboratory data from both years compares quite well even though the times, flows, temperatures and possibly the algae itself were significantly different.

CARBON - CHLOROPHYLL RELATIONSHIP
POTOMAC ESTUARY
(1977 - 1978 DATA)

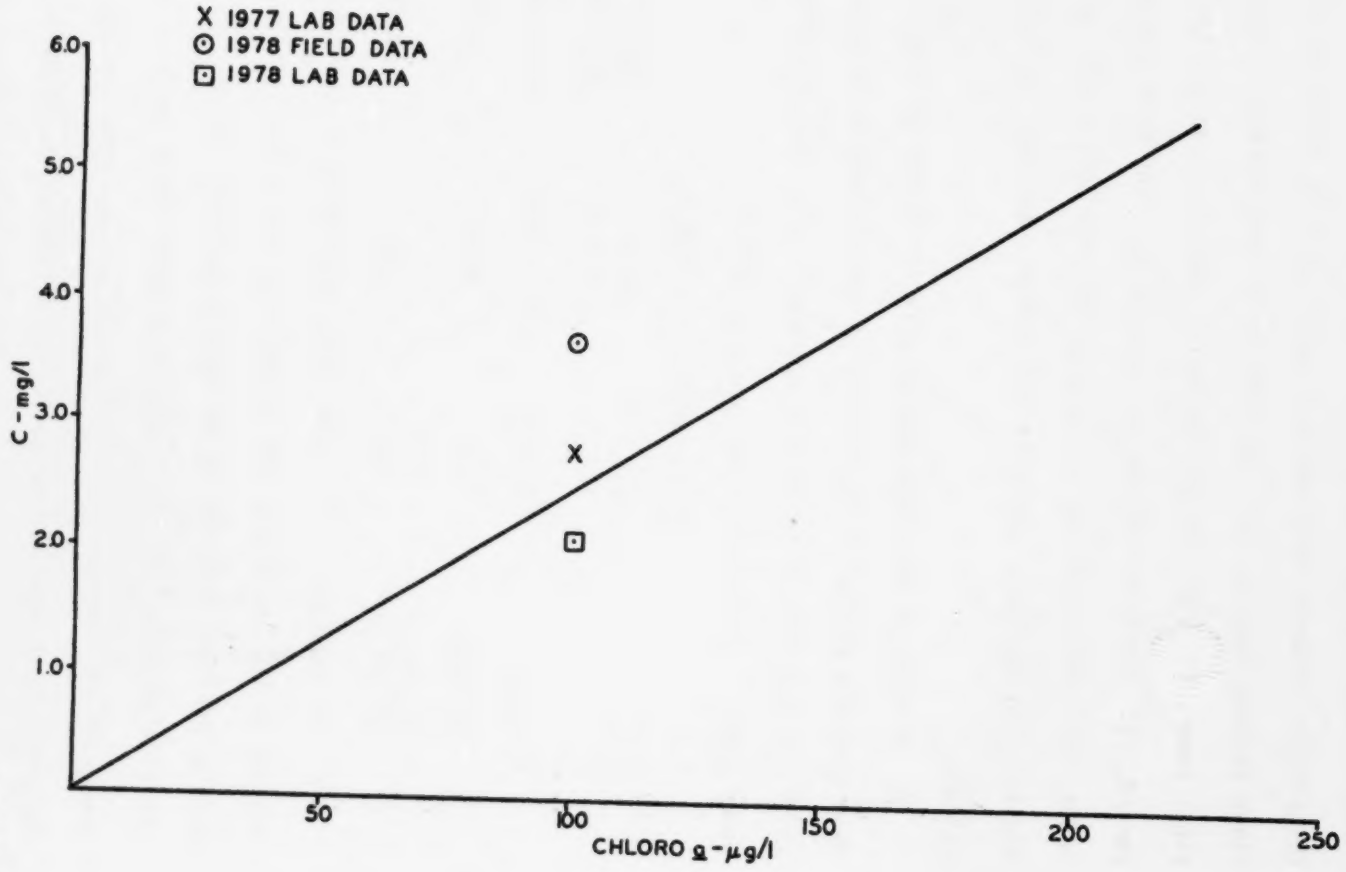


FIGURE-19

NITROGEN - CHLOROPHYLL RELATIONSHIP
POTOMAC ESTUARY
(1977-1978 DATA)

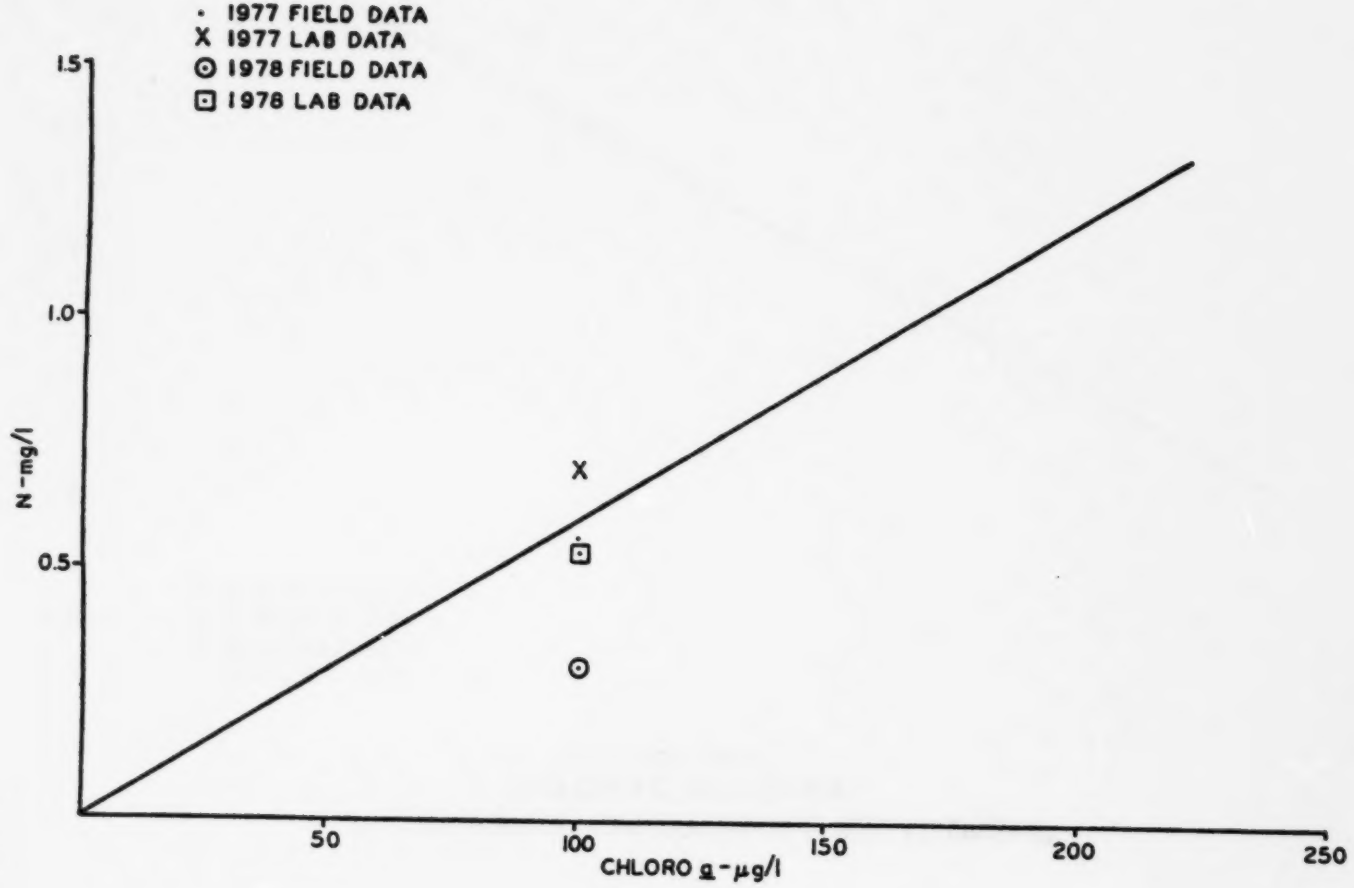


FIGURE-20

PHOSPHORUS - CHLOROPHYLL RELATIONSHIP
POTOMAC ESTUARY
(1977-1978 DATA)

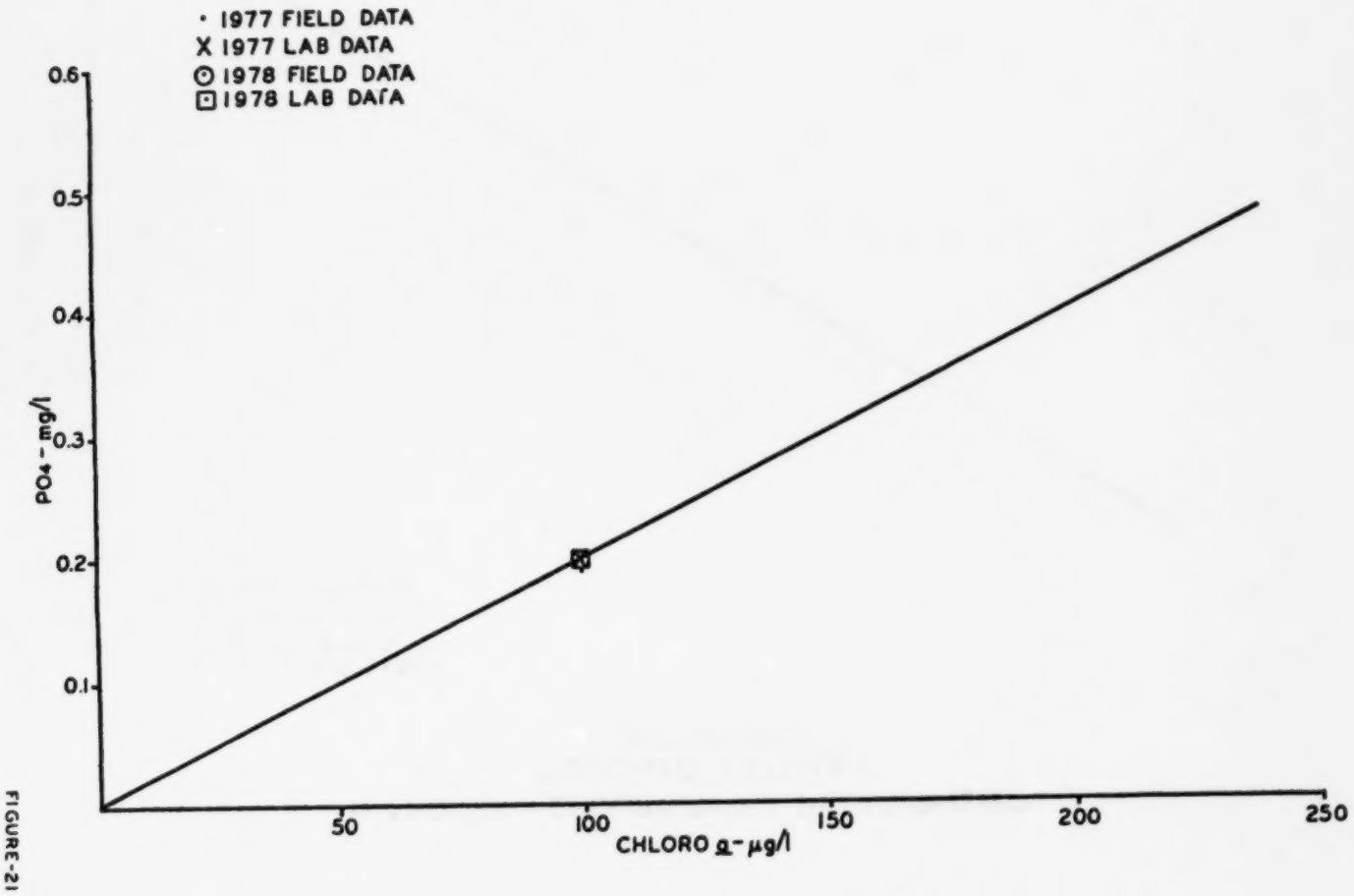


FIGURE-21

In the case of phosphorus, estimates based on field data were identical to the lab measurements. In fact, all 1977 and 1978 phosphorus data coincided. Both carbon and nitrogen data showed more variability, particularly in the field estimates.

The relationships contained in Figures 19 - 21 show that in order to support a bloom with a chlorophyll concentration of 100 µg/l there would theoretically have to be 2.5 mg/l, 0.6 mg/l and 0.2 mg/l of C, N and PO_4, respectively. These translate to atomic C:N:P ratios of 100:20:1.

7. Past Potomac data as well as the technical literature have strongly indicated that algae impart, through their respiration and decay, a major effect on the BOD_5 value. This in turn will have a similar adverse effect on DO which cannot be ignored during certain periods of the summer. An attempt to develop the algae (chlorophyll) - BOD_5 relationship was undertaken in the laboratory [2] and the following results were obtained:

$$\text{Total Algal Effect} - 0.027 \quad \frac{\text{mg } BOD_5}{\mu\text{g Chloro}}$$

$$\text{Algal Decay} - 0.019 \quad \frac{\text{mg } BOD_5}{\mu\text{g Chloro}} \quad (70\% \text{ of Total})$$

$$\text{Algal Respiration} - 0.008 \quad \frac{\text{mg } BOD_5}{\mu\text{g Chloro}} \quad (30\% \text{ of Total})$$

Two important points should be made: (1) there is a very close agreement between the total algal effect on BOD_5 and the carbon content of the algal cells as presented previously (i.e. 0.027 $\frac{\text{mg } BOD_5}{\mu\text{g Chloro}}$ vs. 0.025 $\frac{\text{mg C}}{\mu\text{g Chloro}}$), and (2) during the latter stages of the 1977

Potomac study a significant die-off of algae was observed wherein the BOD_5 increased by 5 - 6 mg/l and DO dropped about the same amount [1]. Assuming the above relationship for algal decay, this 200 µg/l reduction in chlorophyll that occurred should theoretically yield an additional 4 mg/l of BOD_5. If the above respiratory effects were included, the two results would be in close agreement.

D. DO - BOD

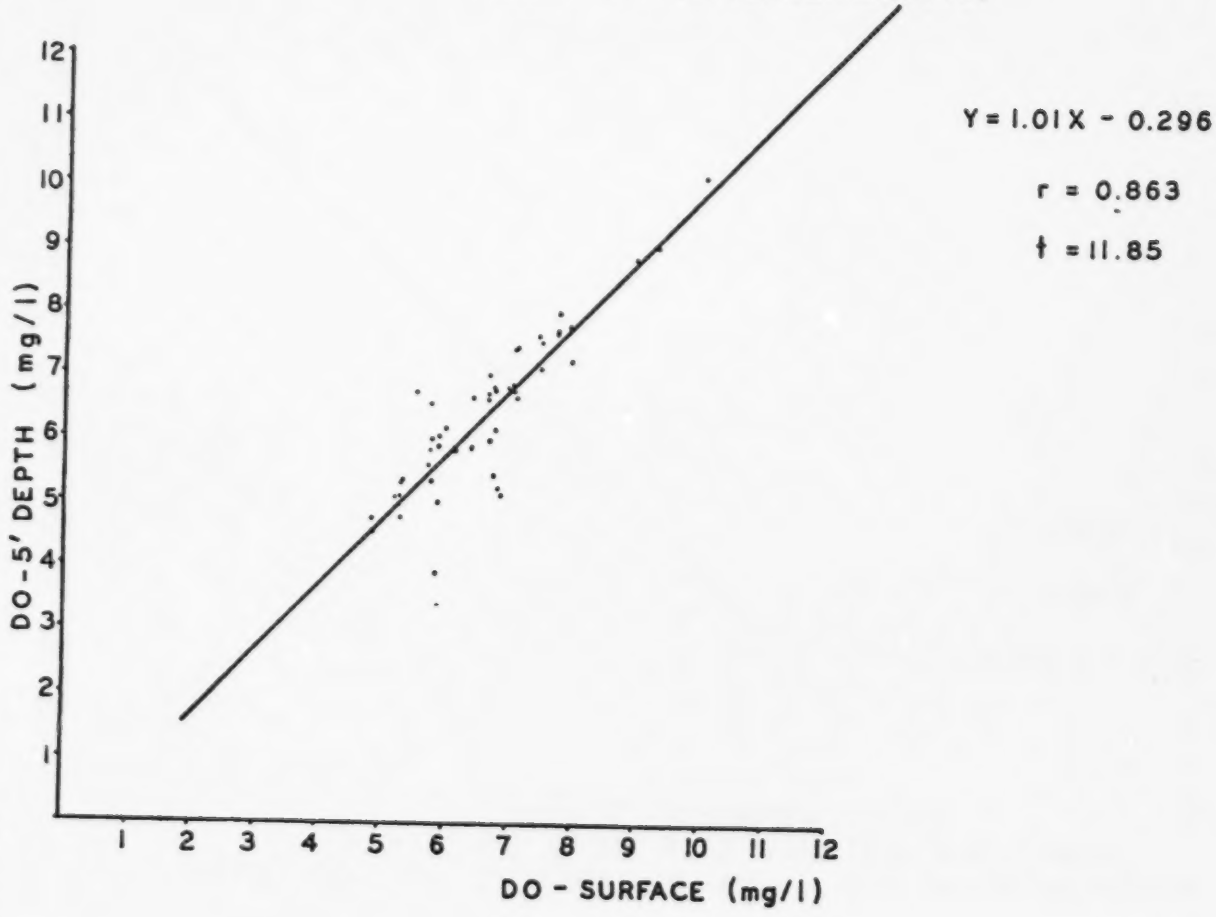
1. Minimum DO concentrations measured during the 1978 Potomac slack water runs were in the range of 4.0 - 4.5 mg/l. These values generally occurred between Piscataway Creek and Gunston Cove following two storm events at the end of July. River flows at the time varied from about 7,000 to 9,000 cfs.

A dramatic improvement in DO was experienced between 1977 and 1978.

2. There is a strong correlation between DO measurements at the surface and at 5' depth at a given point in time and space. The survey data were grouped for stations primarily impacted by Blue Plains (Stations 4, 5, 5A, 6 and 7) as well as for those stations primarily impacted by algae (Stations 8, 8A, 9, 10 and 10B) and then used for regression analysis (Figures 22 and 23). The upper group of stations showed a difference in DO concentrations of about 0.25 mg/l (surface being higher) whereas the lower group showed almost identical results. Segregating the data based upon chlorophyll levels did not change these results appreciably (Figures 24 and 25).

3. Three additional drogue studies were conducted in the Rosier Bluff

RELATIONSHIP OF SURFACE AND 5' DO MEASUREMENTS
STATIONS 4.5,5A,6, AND 7 - POTOMAC
(JULY 17 - SEPTEMBER 27, 1978)



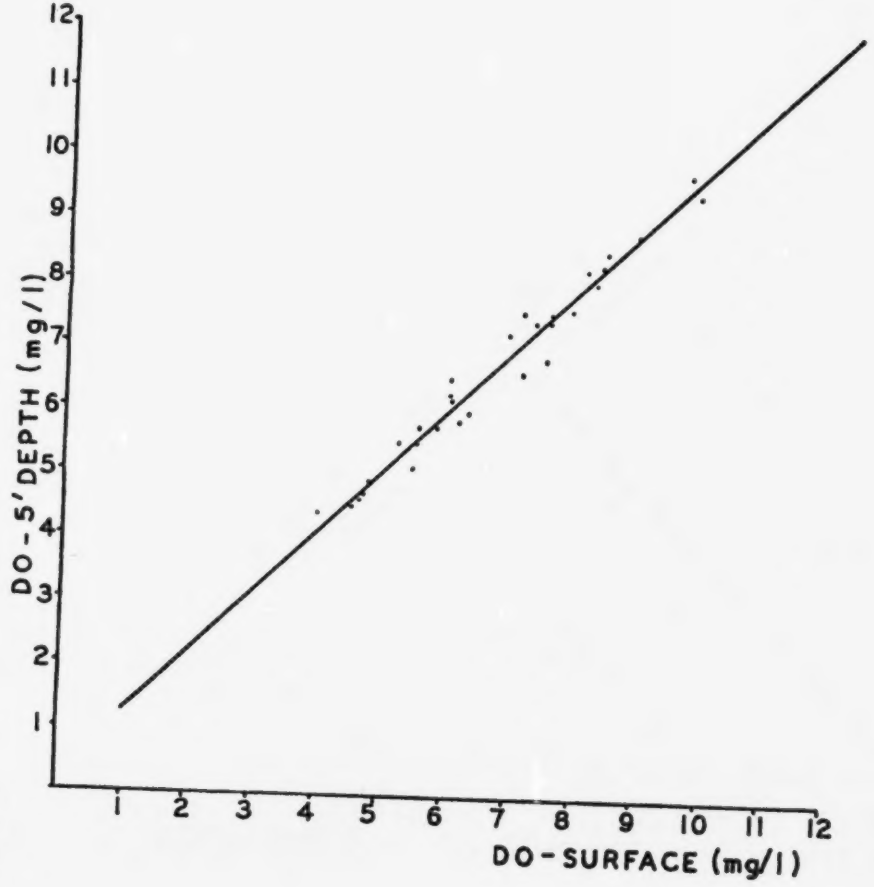
Y = 1.01X - 0.296

r = 0.863

t = 11.85

FIGURE-22

RELATIONSHIP OF SURFACE AND 5' DO MEASUREMENTS
STATIONS 8, 8A, 9, 10, AND 10B - POTOMAC
(JULY 17 - SEPTEMBER 13, 1978)



Y = 0.942X + 0.36

r = 0.985

t = 29.76

FIGURE-23

RELATIONSHIP OF SURFACE AND 5' DO MEASUREMENTS
STATIONS 8, 8A, 9, 10, AND 108 - POTOMAC
(JULY 17 - AUGUST 3 & SEPTEMBER 5, 1978)

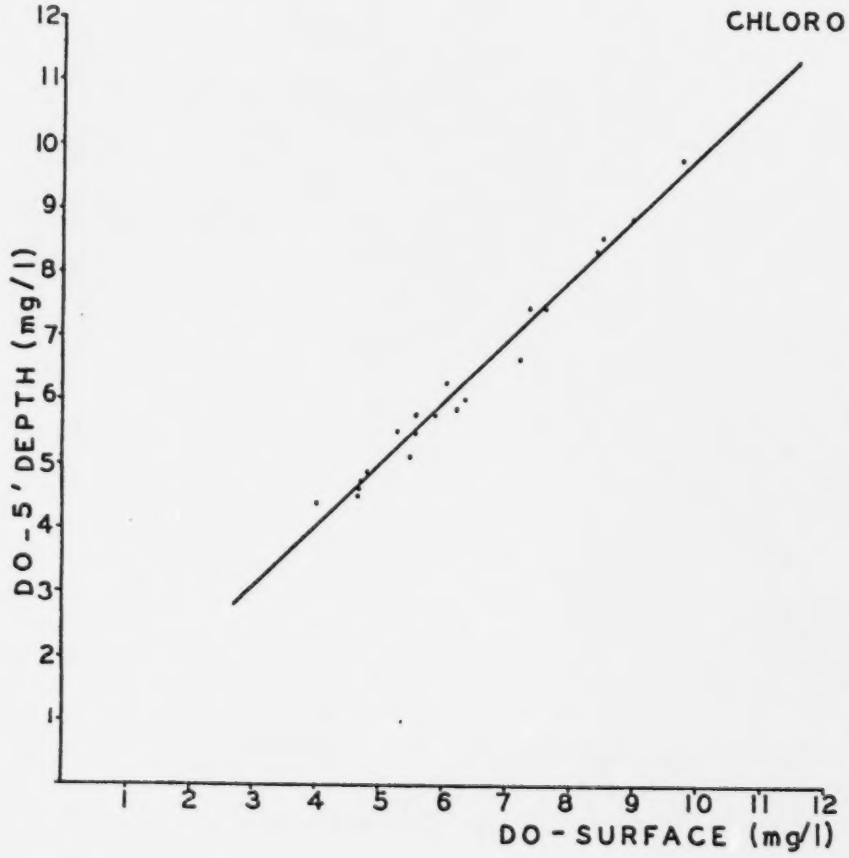


FIGURE-24

RELATIONSHIP OF SURFACE AND 5' DO MEASUREMENTS
STATIONS 8, 8A, 9, 10, AND 10B - POTOMAC
(AUGUST 28 - SEPTEMBER 13, 1978 - EXCLUDING SEPTEMBER 5)

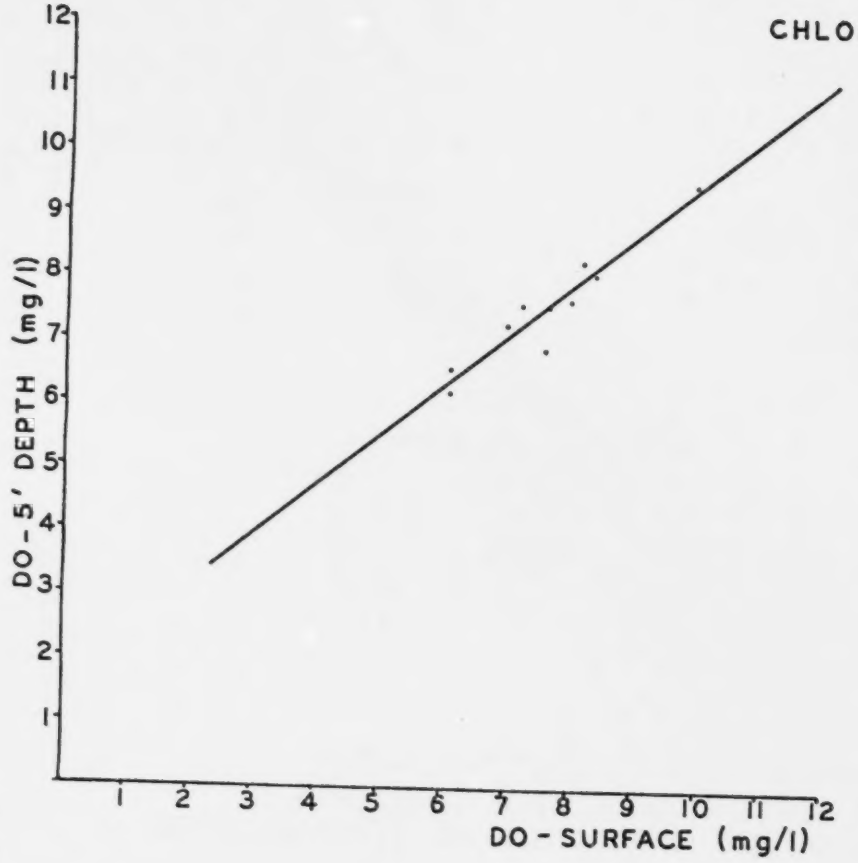


FIGURE-25

to Piscataway reach of the Potomac during 1978. Two of these studies were of 24 hour duration (6:00 a.m. - 6:00 a.m.) and the third had a duration of 10 hours (7:00 a.m. - 5:00 p.m.). Both chlorophyll levels and the amount of diurnal DO variability were unexpectedly low during each of these drogue studies, as can be seen in Figures 26 and 27. Chlorophyll levels varied from 30 to 60 µg/l, the change in surface DO varied from 0.5 to 2.5 mg/l, and the change in bottom DO was 0.5 to 1.5 mg/l. The absolute minimum DO observed during these drogue studies was about 4.0 mg/l, which again indicates significant improvement over the preceding year.

4. A special attempt was made to discern differences between early morning and afternoon DO concentrations at the time and place of peak chlorophyll concentrations. Data from two successive days was used for this purpose. Even with chlorophyll at about 140 µg/l, the diurnal change in surface DO was only between 2.0 and 3.0 mg/l. Again, absolute minimum DO levels at either surface or bottom did not drop below the 4.0 - 4.5 mg/l range. It should be pointed out, however, that by this time (September 27-28) the water temperature had already decreased to about 23°C.

5. Compositing all of the available diurnal DO data collected by AFO produces the relationships shown in Figures 28 and 29. One set of data applies to the surface and the other to the bottom. Given a chlorophyll concentration of 100 µg/l upstream of Piscataway and hot sunny weather one can expect a diurnal DO variation of 4 - 5 mg/l at the surface and about 2 mg/l at the bottom excluding tidal effects. Similarly, when cloudy conditions prevail the surface DO variability drops to about 1 mg/l.

DROGUE STUDY DO DATA
UPPER POTOMAC ESTUARY
(ROSIER BLUFF - PISCATAWAY)

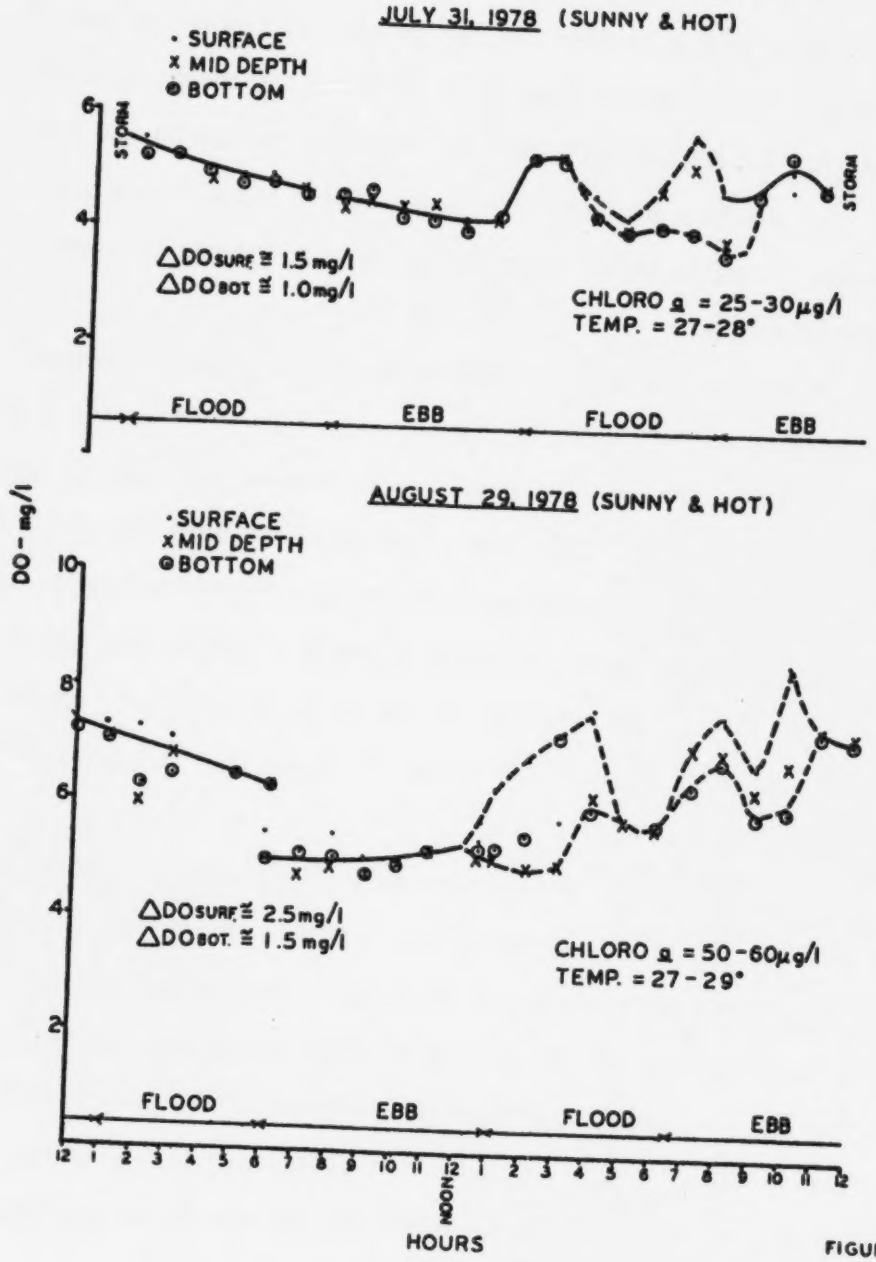


FIGURE-26

DROGUE STUDY DO DATA
POTOMAC ESTUARY (ROSIER BLUFF-PISCATAWAY)

SEPTEMBER 13, 1978 (MOSTLY CLOUDY & COOL)

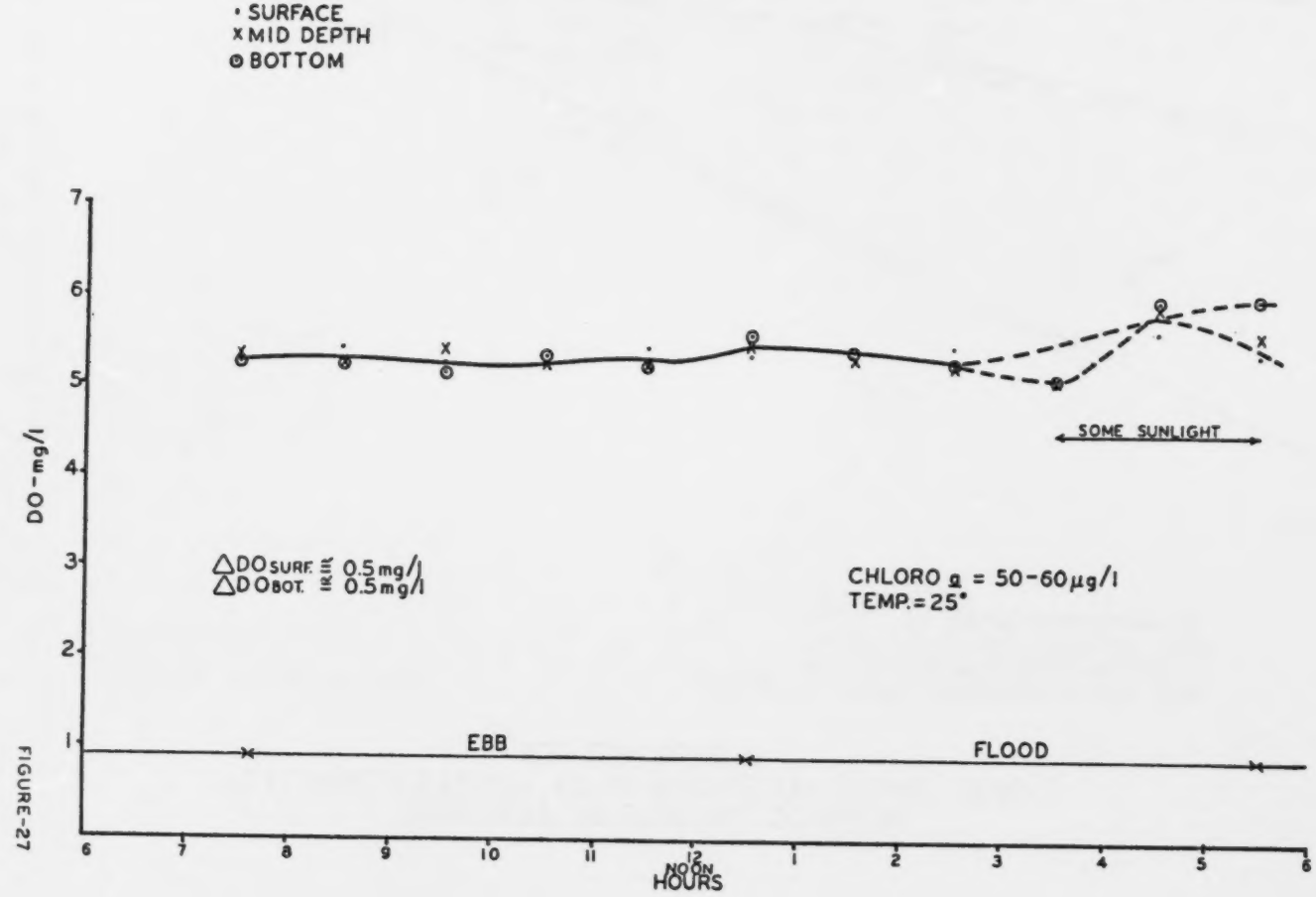


FIGURE-27

SUMMARY OF DIURNAL DO DATA
POTOMAC ESTUARY (W.W. BRIDGE TO INDIAN HEAD)
SURFACE DATA

• 1977-78 DROGUE STUDIES
⊙ PRE 1977 DATA
⊡ SPECIAL 1978 DATA

LEGEND - WEATHER CONDITIONS SUNNY AND HOT UNLESS OTHERWISE NOTED. WATER TEMP. ALSO INCLUDED. DATA COLLECTED ABOVE PISCATAWAY IS NOT LABELLED.

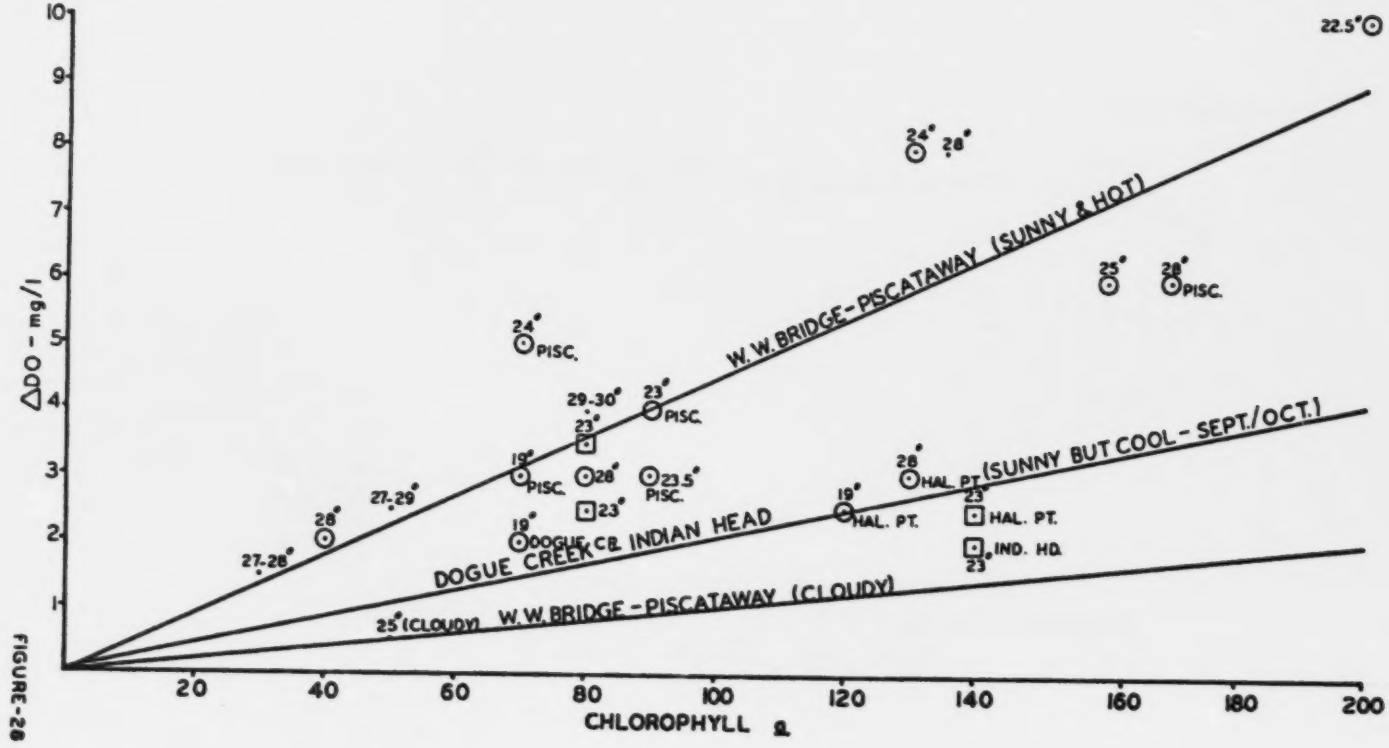


FIGURE-28

SUMMARY OF DIURNAL DO DATA
POTOMAC ESTUARY (W.W. BRIDGE TO INDIAN HEAD)
BOTTOM DATA

• 1978 DROGUE STUDIES
⊙ PRE 1977 DATA
⊡ SPECIAL 1977 DATA

LEGEND - WEATHER CONDITIONS SUNNY AND HOT UNLESS OTHERWISE NOTED. WATER TEMP. ALSO INCLUDED.

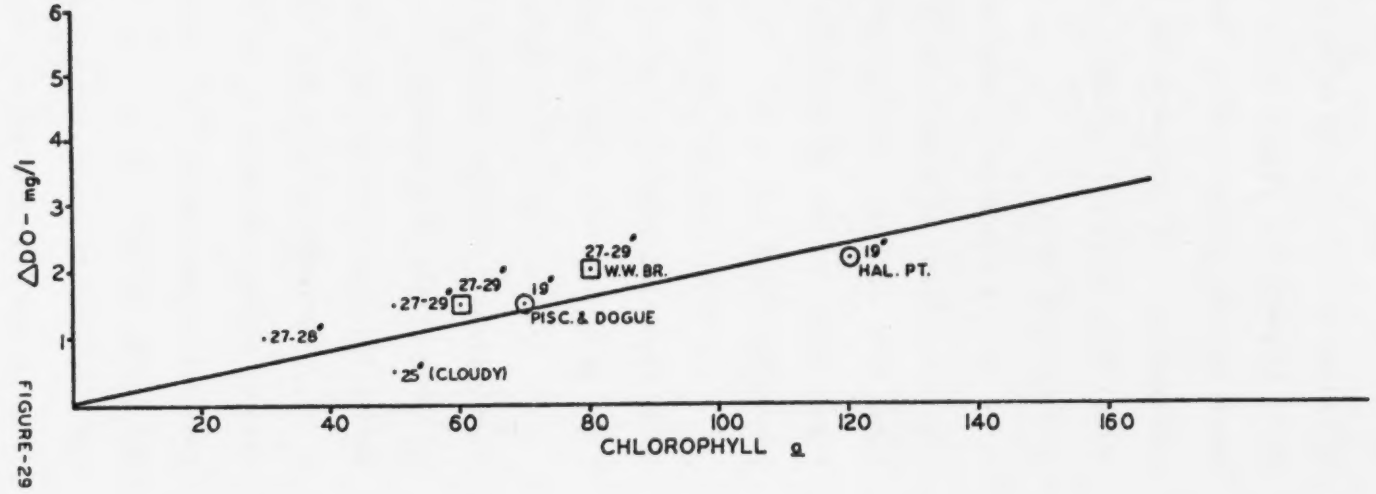


FIGURE-29

6. Valid trends with respect to DO are always difficult to discern because of a large number of influencing factors present. The inter-relationship and relative effects of these factors, such as river flow, water temperature, algae, bacterial populations, etc. are nearly impossible to consider fully. Nonetheless, a somewhat distinct improvement in DO concentrations in the Potomac during higher than normal flow periods is apparent based upon an examination of ten years of historical data.

A six observation data set collected between August 12-14, 1969 when river flows were about 9,000 cfs showed several DO values in the range of 2 - 3 mg/l. Average DO values were as low as 3 - 3.5 mg/l. A year later similar DO concentrations were recorded while flows were averaging 17,000 cfs.

Another data set composed of two observations (July 15 - 16, 1974) also contained DO values in the vicinity of 3.0 mg/l at one station. Flows preceding this sampling were as high as 20,000 cfs.

A third data set collected during July 7-22, 1975 (2 - 3 observations), however, produced DO concentrations that were comparable to those of the 1978 survey, i.e. 4 - 5 mg/l minimum. Average flows during this period were about 10,000 cfs.

7. Two projects were undertaken during 1978 to better define the role of bottom sediments on the DO budget. One was to obtain additional sediment oxygen demand (SOD) measurements using the same equipment and procedures as last year and the other was to perform a cursory mapping and characterization of the bottom sediment using visual means. The 1978 SOD results obtained are shown in the table below:

Station	Rate ($gr/M^2/day$)	Temperature (^oC)
Bellevue - Virginia Side	3.6	28.0
Opposite Blue Plains New Outfall	2.3	26.0
Buoy N "4" Downstream from Goose Island	3.0	28.2
Woodrow Wilson Bridge - Maryland Side	2.3	22.4
Upstream of Rosier Bluff along Maryland Shore	3.7	26.5
Broad Creek (Upstream End) (2 Measurements Made)	1.4 1.2	21.5 22.5
Opposite Little Hunting Creek (Virginia Side)	3.9	28.0
Dogue Creek (Downstream End)	5.5	25.5
Hallowing Point (Maryland Side)	3.3	26.0
Opposite Occoquan Bay	8.5	24.8
Cockpit Point (Virginia Side)	11.4	29.0
Upstream of Sandy Point (Mid-channel)	3.5	21.0

In addition, both the 1977 and 1978 measured SOD values, corrected to 20°C by using a temperature correction factor of 1.065, are presented in Figure 30.

Probing and selected sediment sampling was performed throughout a grid consisting of 26 transects each of which contained three stations in the lateral plane. The transects extended from Bellevue to Smith Point (river mile 10 to 46). The bottom sediment was characterized (i.e. hard or soft sand, clay, mud, etc.) based upon these observations. Much of the bottom was found to be soft in nature with sand being the predominant material. While a mixture of soft mud and clay was also detected at many stations there was no instance where grossly contaminated

POTOMAC ESTUARY WATER QUALITY DATA

TIME PERIOD

- 1977
- 1978

FLOW

← ARLINGTON
← BLUE PLAINS
← ALEXANDRIA
← WESTGATE
← PISCATAWAY
← HUNTING CR.
← DOGUE CR.
← POHICK CR.

TEMPERATURE

PARAMETER(S)

SEDIMENT OXYGEN DEMAND (SOD)

VALUES CORRECTED TO 20°C ($\theta = 1.065$)

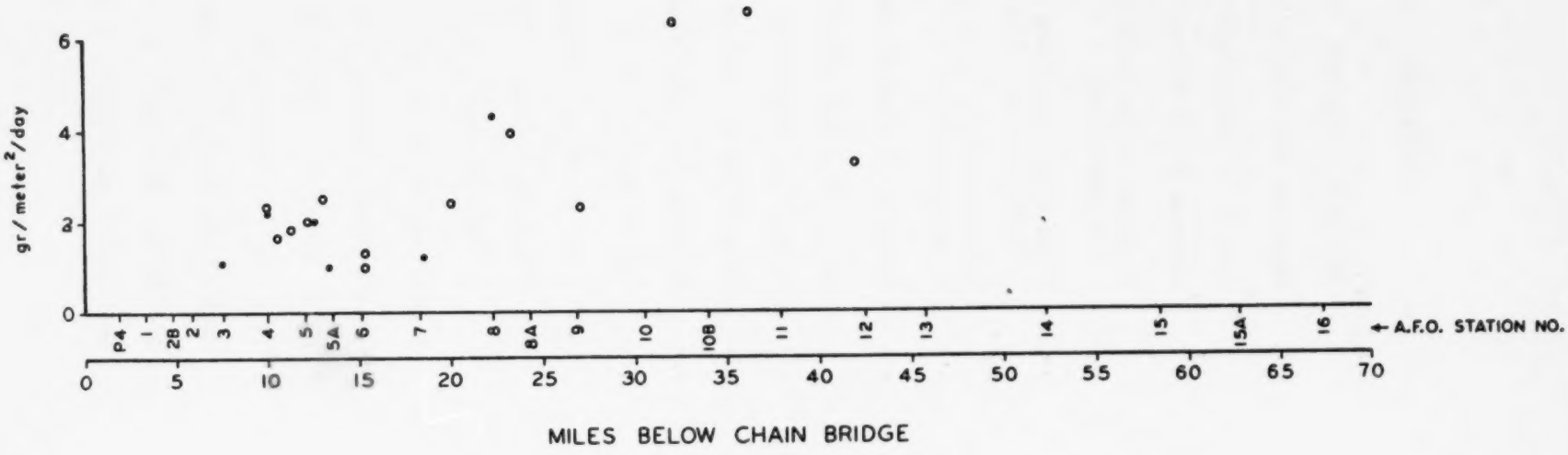


FIGURE - 30

sludge deposits or other highly suspicious material was present at the time of this survey.

8. Distributions of BOD_5 obtained during alternate slack water runs exhibited considerable variability and a low degree of correlation with DO. In general, BOD_5 concentrations were higher in the reach upstream from Indian Head where maximum values ranging between 4.0 mg/l and 8.0 mg/l were recorded. The upper end of this range was experienced during the low flow period in September whereas the lower values were produced by the high flows occurring in July and August. The downstream half of the study reach (Indian Head - 301 Bridge) showed BOD_5 values in the range of 1.0 - 4.0 mg/l with a similar temporal trend as the upper reach.

9. Long-term (i.e. 20 day) BOD analyses were performed, with and without a nitrification inhibitor, on both river and sewage treatment plant effluent samples in order to shed light on reaction kinetics and rates [2]. The following first-order reaction rates were obtained from this study.

River Samples
(no exclusion of ambient algal effects)

CBOD - 0.12/day (base e - 20°C) (Standard Deviation = 0.03)

NBOD - 0.10/day (base e - 20°C) (Standard Deviation = 0.06)

The average ratio of $CBOD_5$ to BOD_5 (no inhibitor) was determined to be 0.58. (Standard Deviation = .15)

Effluent Samples

CBOD - 0.16/day (base e - 20°C) (Standard Deviation = 0.05)

NBOD - statistically inconclusive because of significant lag period.

Given the kinetic data for the treatment plant effluents, it has been determined that the $CBOD_{ult}/CBOD_5$ ratio is about 1.8, which is quite close to the value (1.75) obtained during the 1977 study. Because of the aforementioned lag for NBOD, it has further been determined that there was an appreciable difference between the $CBOD_{ult}/CBOD_5$ and the $CBOD_{ult}/BOD_5$ ratios. The latter ratio had to be calculated in a different fashion since 5-day BODs were not directly obtained during the long term lab tests. Its average value, 1.3, was nevertheless identical to that of last year.

E. Point Source Assessment

1. A summary of all the effluent data collected during this study is presented in Tables 5 and 6. The first table contains pollutant concentrations whereas the second contains pollutant loadings.

Blue Plains still constitutes, by far, the largest single point source in the Washington Metropolitan Area. Of the average total point source loading, it alone accounts for 85% of the BOD_5 (77,000 lbs/day), 77% of the TOC (45,000 lbs/day), and 58% of the inorganic PO_4 (5,700 lbs/day).

2. An examination of Table 5 reveals that there is considerable variability in effluent concentrations and quite possibly in treatment plant efficiency. This is particularly true with respect to BOD_5, where the standard deviation values were 50% or more of the mean for most facilities. While the data is limited, it does not appear that this relatively large variability in BOD_5 is attributable to storm events or exceptionally high wastewater inflows. It could, however, be partly attributable to the inherent imprecision of the test itself.

TABLE 5

S.T.P. Effluent Data Summary
Pollutant Concentrations

Facility	Flow (mgd)	BOD_5	TOC	TKN	NH_3	$NO_2 + NO_3$	TPO_4	Inorg PO_4	Inorg N: Inorg P (by atoms)	
		←			mg/l			→		
Blue Plains	308	30.3	17.5	14.7	13.1	0.5	4.3	2.2	42:1	Mean
	163-378	9.6-56.2	13.7-27.6	9.4-22.1	9.4-15.9	0.2-0.9	2.8-7.8	1.0-3.6		Range
	49	17.2	4.5	2.8	1.9	0.2	1.5	0.9		S.D.
Arlington	23	23.0	13.1	19.6	18.6	1.2	9.6	6.5	20:1	Mean
	19-26	4.5-51.0	7.4-40.2	14.4-34.4	11.8-34.4	0.1-5.8	2.2-17.4	0.4-15.5		Range
	2	15.1	8.8	5.4	5.7	1.5	4.3	4.8		S.D.
Alexandria	29	46.5	23.8	18.9	18.6	0.1	3.2	0.7	181:1	Mean
	23-37	27.0-72.8	15.2-36.4	11.7-24.2	10.5-31.5	<0.1-0.2	0.6-8.2	<0.1-3.8		Range
	4	19.0	5.3	3.0	5.1	<0.1	2.0	1.0		S.D.
Piscataway	17	20.0	9.4	10.9	10.1	5.2	2.6	1.5	69:1	Mean
	11-29	9.6-30.5	4.8-15.1	7.7-14.6	7.7-14.6	3.0-9.8	1.8-3.6	0.2-1.9		Range
	4	9.1	2.6	2.4	2.4	1.9	0.6	0.5		S.D.
Lower Potomac (Pohick Creek)	16	11.4	16.3	19.8	18.7	1.3	17.1	14.6	9.5:1	Mean
	15-18	3.6-20.4	9.3-21.6	13.6-27.4	9.3-27.4	<0.1-5.7	14.2-22.6	10.0-19.7		Range
	1	6.1	3.4	3.9	4.8	1.9	2.8	2.4		S.D.
Westgate	4.2	15.3	14.0	17.3	16.5	0.1	17.5	14.9	7.5:1	Mean
	2.8-8.9	3.5-27.0	11.1-21.0	15.1-20.3	14.5-18.9	<0.1-0.3	9.2-33.0	7.8-21.7		Range
	2.1	8.0	2.9	1.6	1.6	<0.1	6.7	4.2		S.D.
Dogue Creek	2.6	10.8	14.7	18.4	17.4	1.1	0.8	0.1	1250:1	Mean
	2.3-3.2	6.3-15.6	8.4-17.6	14.0-22.4	13.6-22.4	0.9-1.5	0.6-1.1	<0.1-0.2		Range
	0.2	3.5	3.0	2.7	2.4	0.2	0.2	0.3		S.D.
Hunting Creek	4.8	15.2	12.5	18.2	17.2	2.2	0.8	0.1	1300:1	Mean
	4.3-5.9	6.0-30.8	10.3-15.2	15.1-20.4	10.9-20.4	1.7-2.7	0.5-1.4	<0.1-0.2		Range
	0.4	8.6	1.8	1.6	2.5	0.4	0.3	<0.1		S.D.

TABLE 6

S.T.P. Effluent Data Summary
Pollutant Loadings (Average)

Facility	BOD_5 #/d	%	TOC #/d	%	TKN #/d	%	NH_3 #/d	%	$NO_2 + NO_3$ #/d	%	TPO_4 #/d	%	Pi (as PO_4) #/d	%
Blue Plains	77,000	85	45,000	77	38,000	73	33,000	71	1,300	51	11,000	65	5,700	58
Arlington	2,900	3	2,500	4	3,800	7	3,600	8	200	8	1,800	11	1,300	13
Alexandria	7,200	8	5,800	10	4,500	9	4,400	9	30	1	800	5	200	2
Piscataway	1,700	2	1,300	2	1,500	3	1,400	3	700	28	400	2	200	2
Lower Potomac (Pohick Cr.)	1,000	1	2,200	4	2,700	5	2,500	5	200	8	2,300	14	2,000	20
Westgate	200	Neg.	500	1	600	1	600	1	Neg.	Neg.	600	3	500	5
Dogue Creek	100	Neg.	300	Neg.	400	1	400	1	20	1	20	Neg.	Neg.	Neg.
Hunting Creek	400	Neg.	500	1	700	1	700	2	90	3	30	Neg.	Neg.	Neg.
Totals	90,500		58,100		52,200		46,600		2,540		16,950		9,900	

3. A ten year trend in wastewaste loadings to the upper Potomac Estuary is shown in Table 7. Of particular interest is the dramatic reduction in phosphorus loads and its effect on shifting the N:P ratio a factor of five fold between 1968 and 1978.

F. Chain Bridge Inputs

1. Tables 8 and 9 present all of the pollutant concentration data for the Chain Bridge station in chronological order for 1978 and 1977 respectively. In addition, the average concentrations and standard deviations are presented for comparison purposes.

Although the two summer sampling seasons were significantly different from the standpoint of river flows (6,300 cfs vs. 1,700 cfs), it can readily be seen that the average concentrations for most of the parameters were remarkably similar. The major exception was nitrates which is "land" related and generally reflects a strong dependency on river flow. Soluble inorganic phosphorus also appeared to increase in a similar proportion with flow, although its absolute concentration values were much lower than nitrates. Because of these proportional increases, the N:P ratios did not exhibit a dramatic trend as a function of flow over the range in flows that were monitored. During low river flow periods both inorganic nitrogen and phosphorus were approaching or below minimum detection levels on a consistent basis.

2. There is a consistent 0.5 mg/l of TKN entering the Potomac Estuary at Chain Bridge of which the majority (>0.4 mg/l) is in the form of organic nitrogen. Other representative concentration values at this station are 2.5 mg/l BOD_5, 0.3 mg/l total phosphorus, and 5.0 mg/l total organic carbon.

TABLE 7

Wastewater Loading Trend
Upper Potomac Estuary

Parameter	1968	1977	1978
Flow (cfs)	320	360	405
BOD_5 (#/d)	136,000	74,000	90,000
TOC (#/d)	100,000	82,000	58,000
TKN (#/d)	55,000	49,000	52,000
NH_3 (#/d)	41,000*	43,000	47,000
$NO_2 + NO_3$ (#/d)	3,700	1,800	2,500
TPO_4 (#/d)	71,000	22,000	17,000
Pi as PO_4 (#/d)	46,000**	16,000	9,900
Inorg N:Inorg P (by atoms)	6.8:1	20:1	34:1

*Assume 75% of TKN (based on other historical data)

**Assume 65% of TPO_4 (based on other historical data)

TABLE 8

1978 Chain Bridge Data
Pollutant Concentrations

Date	Flow	TOC	TKN	Part. Org N	Sol. Org N	NH_3	$NO_2 + NO_3$	TPO_4	Sol. Org PO_4	Sol. Inorg PO_4	N:P	BOD_5	DO	Chloro
7/17	6,050	3.3	.45	0	.39	.06	.6	.21	0	.04	110	-	8.26	31
7/19	6,090	4.7E	.49	.21	.24	.04	.73	.24	.02	.04	130	3.7	8.5	52
8/1	9,330	6.22	.47	.27	.16	.04	.27	.87	.0	.04	53	-	7.2	43
8/3	7,190	3.78	.5	.14	.27	.09	1.08	.37	.08	.12	66	0.9	7.73	24
8/14	16,500	5.99	.3	.07	.19	.04	1.08	.67	.02	.2	38	-	8.35	-
8/16	14,500	5.4	.46	.10	.32	.04	1.18	.7	.05	.24	35	1.6	7.8	-
8/28	3,250	3.3	.45	.09	.28	.08	.2	.2	-	.04	47	-	7.88	31
8/30	4,040	3.3	.36	.13	.19	.04	.15	.2	.05	.04	33	2.9	7.7	27
9/5	5,530	5.67	.87	-	-	-	.91	.25	.06	.04	-	4.7	8.05	42
9/11	2,660	5.93	/54	.01	.45	.08	.42	.27	.06	.06	56	-	8.17	24
9/13	2,760	6.95	.46	0	.38	.08	.4	.28	.08	.05	65	2.7	8.1	39
9/25	2,290	3.55	.67	.07	.56	.04	.69	.22	.07	.09	55	-	9.0	21
9/27	2,190	8.17	.62	.07	.51	.04	.58	.21	-	.04	105	1.9	9.13	27
Avg.	6,340	5.1	.51	.10	.33	.06	.64	.36	.04	.08	66	2.6	8.14	33
S.D.	4,610	1.6	.14	.08	.13	.02	.35	.23	.03	.07	32	1.3	.53	9.8

TABLE 9

1977 Chain Bridge Data
Pollutant Concentrations

Date	Flow	TOC	TKN	Part. Org N	Sol. Org N	NH_3	$NO_2 + NO_3$	TPO_4	Sol. Org PO_4	Sol. Inorg PO_4	N:P	BOD_5	DO	Chloro
7/18	2,140	8.77	.4	.28	.08	.05	0	.32	.1	0	U.D.	2.5	6.73	31.5
7/20	1,740	5.81	.74	.26	.4	.09	.05	.26	.05	.03	32	3.2	6.43	34.5
7/25	2,710	1.12	.49	.17	.29	.03	0	.26	.07	0	U.D.	1.9	7.21	42
7/27	1,990	2.76	.46	.2	.26	0	0	.29	.1	0	U.D.	1.5	7.97	52.5
8/1	1,700	8.62	.41	.22	.2	0	0	.23	.07	0	U.D.	3.0	7.38	12
8/3	1,340	4.45	.44	.16	.19	.09	.14	.23	.08	0	U.D.	1.7	7.37	25.5
8/22	1,790	7.84	.62	.32	.30	0	0	.29	.08	0	U.D.	3.4	7.78	91.5
8/24	2,550	4.08	.48	.13	.34	.02	.06	.25	.08	0	U.D.	4.0	7.91	79.5
8/29	970	2.27	.47	.14	.32	0	0	.22	.07	.01	0	3.0	7.62	34.5
8/31	1,010	3.47	.47	.01	.43	.03	.05	.22	.08	.01	54	2.8	7.22	19.5
9/6	1,090	3.71	.46	.19	.25	.03	0	.2	.08	0	U.D.	2.0	7.61	46.5
9/8	1,170	12.3	.46	.16	.23	.07	.07	.21	.04	.05	19	2.0	7.7	45
Avg.	1,680	5.4	.49	.19	.27	.03	.03	.25	.08	.01	41	2.6	7.41	43
S.D.	590	3.3	.10	.08	.10	.03	.04	.04	.02	.01	-	.8	.46	23

3. Table 10 presents a ten year loading trend for Chain Bridge. Substantial reductions, ranging between 25 and 60 percent, occurred during this period for several of the water quality constituents, including BOD_5 and phosphorus. It is important to note too that the ratio of inorganic nitrogen to phosphorus changed by almost a factor of two.

G. Urban Inputs

1. For purposes of this report an attempt was made to develop crude (order of magnitude) estimates of pollutant loads entering the Potomac Estuary from the highly urbanized portion of the Washington metropolitan complex during this study period. These estimates, which distinguish between combined sewer overflows and other runoff conveyed through a storm sewer system, were based upon compositing and examining (without the aid of a model) a variety of data collected and reported by the following:

O'Brien & Gere, Consulting Engineers [3]

Roy Weston, Consulting Engineers [4]

Metcalf & Eddy, Consulting Engineers [5]

Northern Virginia Planning District [6]

Virginia Polytechnic Institute [7]

Washington Council of Governments [8]

2. Table 11 depicts the combined sewer and storm sewer BOD, nitrogen, and phosphorus loadings for each of the appreciable storm events recorded at Washington National Airport. It can be seen that the storm sewer loads are quite significant, far overshadowing the

TABLE 10

Pollutant Loading Trend
Potomac River at Chain Bridge

Parameter	1968	1977*	1978*	***
Flow (cfs)	2,780	1,680	6,350	2,780
BOD_5 (#/d)	52,800	23,000	88,000	38,000
TOC	87,500	49,000	174,000	80,000
TKN	14,500	4,600	11,500	7,500
NH_3	1,800	480	1,700	800
$NO_2 + NO_3$	1,500	1,400	18,000	3,800
TPO_4 (as PO_4)	4,800	2,200	13,000	4,200
Pi (as PO_4)	700**	260	2,500	620
Inorg N:Inorg P (by atoms)	32:1	49:1	54:1	50:1

*Based on regression analysis using 1977-79 data base

**Assume 15% of TPO_4 (based on other historical data)

***Estimated (regression analysis) for same flow as 1968 (i.e. 2,780 cfs)

TABLE 11

Estimated Urban Loadings During
1978 Study Period
(based on area of 3.0 mi^2 or 192,000 ac)

Date	Rainfall (in)	Combined Sewers			Storm Sewers		
		BOD_5	TN	TP	BOD_5	TN	TP
		← 10^3 lbs →					
7/30	0.35	22	2	1	250	26	8
7/31	0.85	57	6	2.5	490	48	18
8/4	0.50	33	3	1	330	34	11
8/5	0.45	30	3	1	300	32	10
8/9	0.30	17	2	1	210	24	6
8/11	0.60	40	4	2	380	38	13
8/13	1.20	77	8	4	610	58	26
8/27	0.35	22	2	1	250	26	8
8/30	2.00	118	12	6.5	810	78	43
9/12	0.55	37	4	1.5	350	36	12
9/22	0.25	13	1	0.5	180	21	5
TOTALS	7.4	466	47	22	4,160	421	160

combined sewer overflows. This is due to the fact that a runoff area of 300 mi^2 or 192,000 acres (approximately the area within the Capital Beltway) was assumed for storm water inputs whereas combined sewers only serve an area of about 12,000 acres.

3. The relative significance of all major load input categories based upon a total mass emission during the study period is presented in Table 12. Of interest to note is the similiarity between, and the dominance of point source and upper basin loads. Even their N:P ratios are remarkably close. The upper basin loads are extremely significant because of the high flows experienced during portions of the study period. Urban inputs are also very important with respect to all three parameters, expecially BOD. Their loads take on added importance when it is considered that they are introduced in only about a dozen days or 1/6 of the entire study period.

TABLE 12

Delineation of Major Pollutant Loads
Upper Potomac Estuary
(1978 Study Period)

Parameter	Input Category			
	Point Source	Upper Basin	CSO	Urban
BOD_5	6.6×10^6	7.1×10^6	4.7×10^5	4.2×10^6
Total N (lbs)	4.0×10^6	3.8×10^6	0.5×10^5	0.4×10^6
Total P (lbs)	0.4×10^6	0.39×10^6	0.2×10^5	0.16×10^6

REFERENCES

1. Assessment of 1977 Water Quality Conditions in the Upper Potomac Estuary, by Leo J. Clark and Stephen E. Roesch, July 1978

2. Biochemical Studies of the Potomac Estuary - Summer 1978, by Joseph Lee Slayton and E. Ramona Trovato, May 1979

3. Phase 1 - Combined Sewer Overflow Study, Potomac - Anacostia River System, by O'Brien and Gere Engineers, March 1979

4. Combined Sewer Overflow Abatement Alternatives, Washington, D.C., by Roy F. Weston, Inc., August 1970

5. Reconnaissance Study of Combined Sewer Overflows and Storm Sewer Discharges, by Metcalf and Eddy Engineers, March 1973

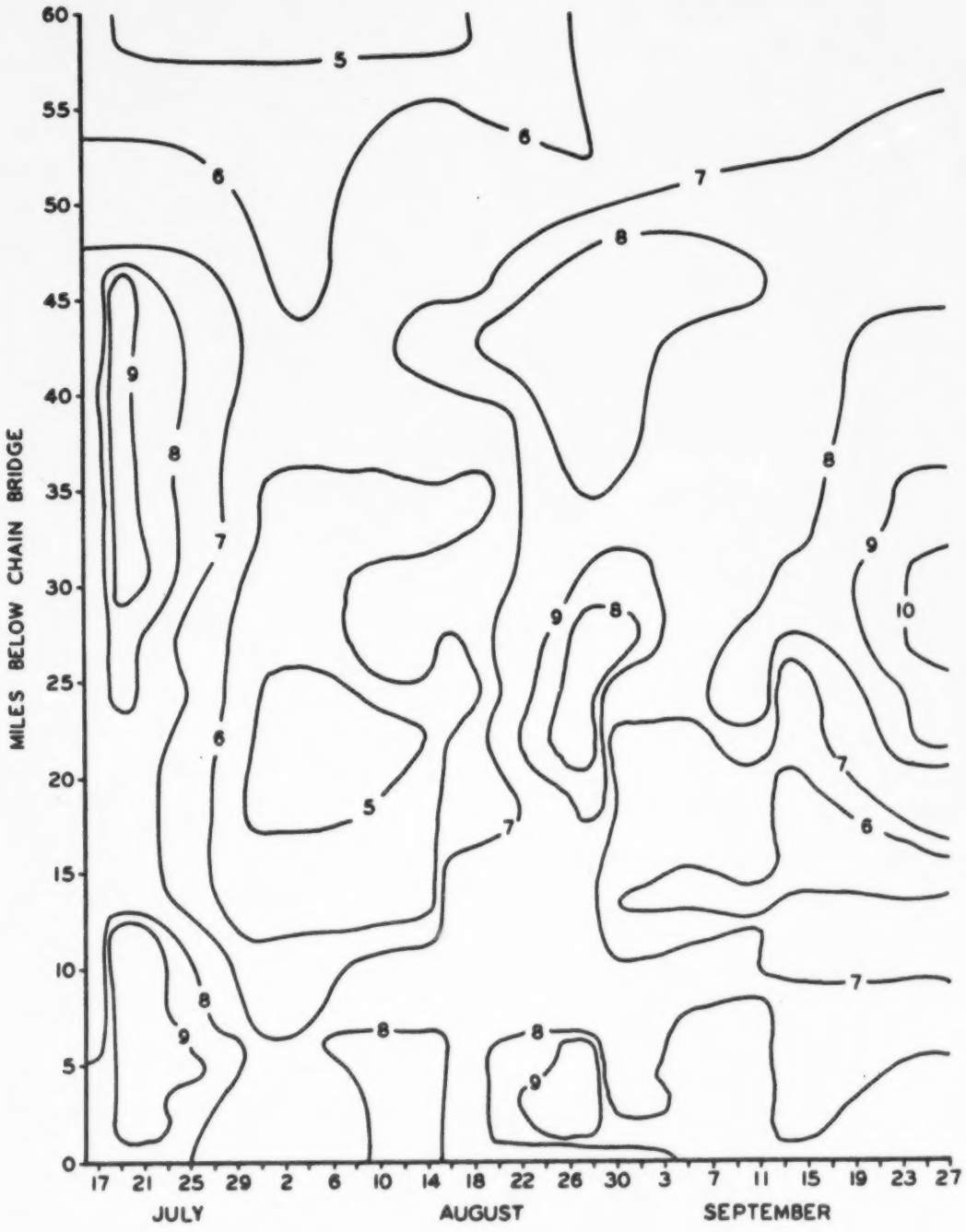
6. Occoquan/Four Mile Run Non-Point Source Correlation Study, prepared by Northern Virginia Planning District Commission and Department of Civil Engineering, Virginia Polytechnic Institute, July 1978

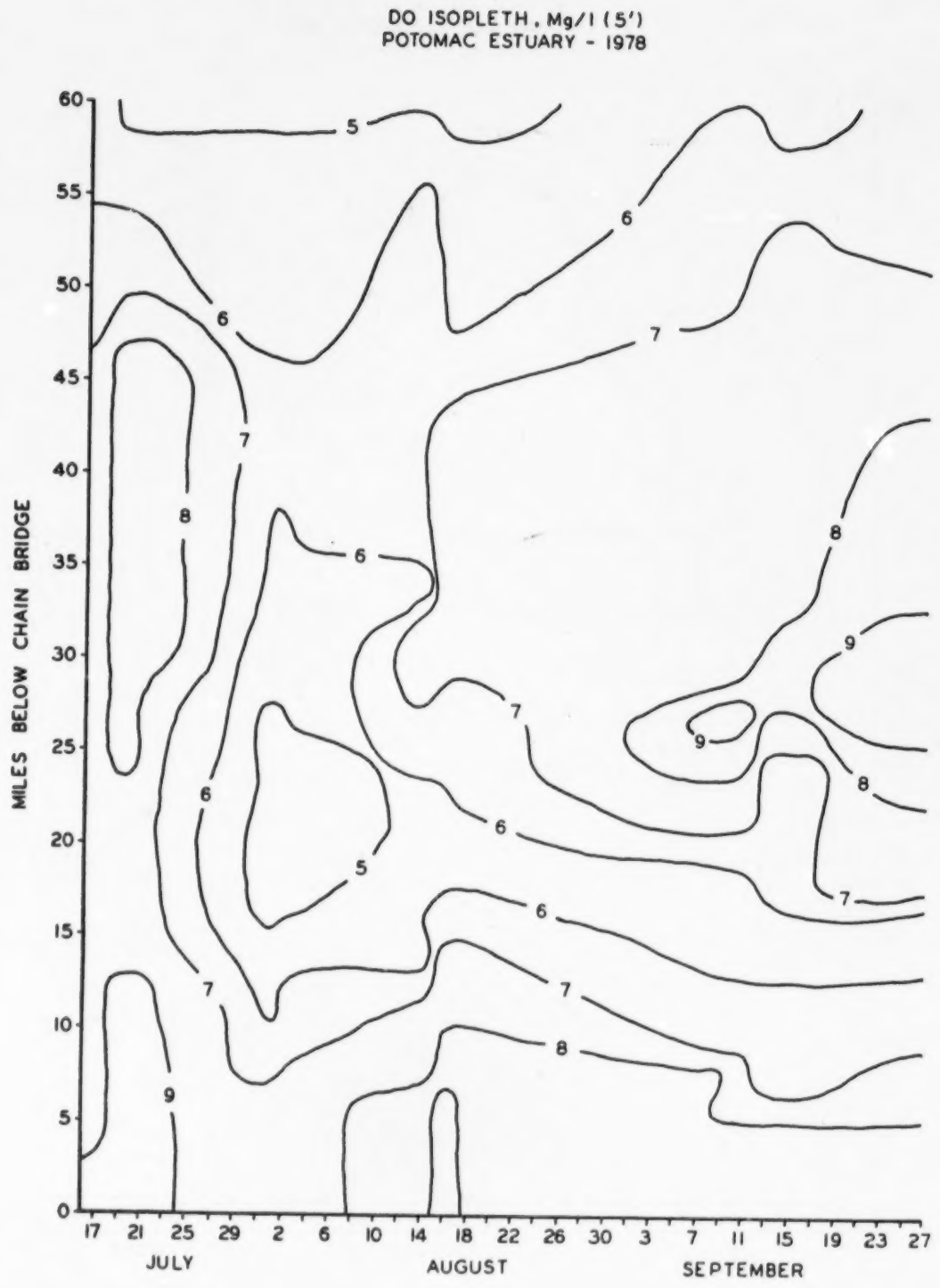
7. Impact of Urban Runoff on Water Quality in the Occoquan Watershed, by Clifford W. Randall, Thomas J. Grizzard and Robert C. Hoehn, Department of Civil Engineering, Virginia Polytechnic Institute - Bulletin 80, May 1978

8. Grant Application Report for Urban Runoff Demonstration Project, prepared by Washington Council of Governments, May 1979

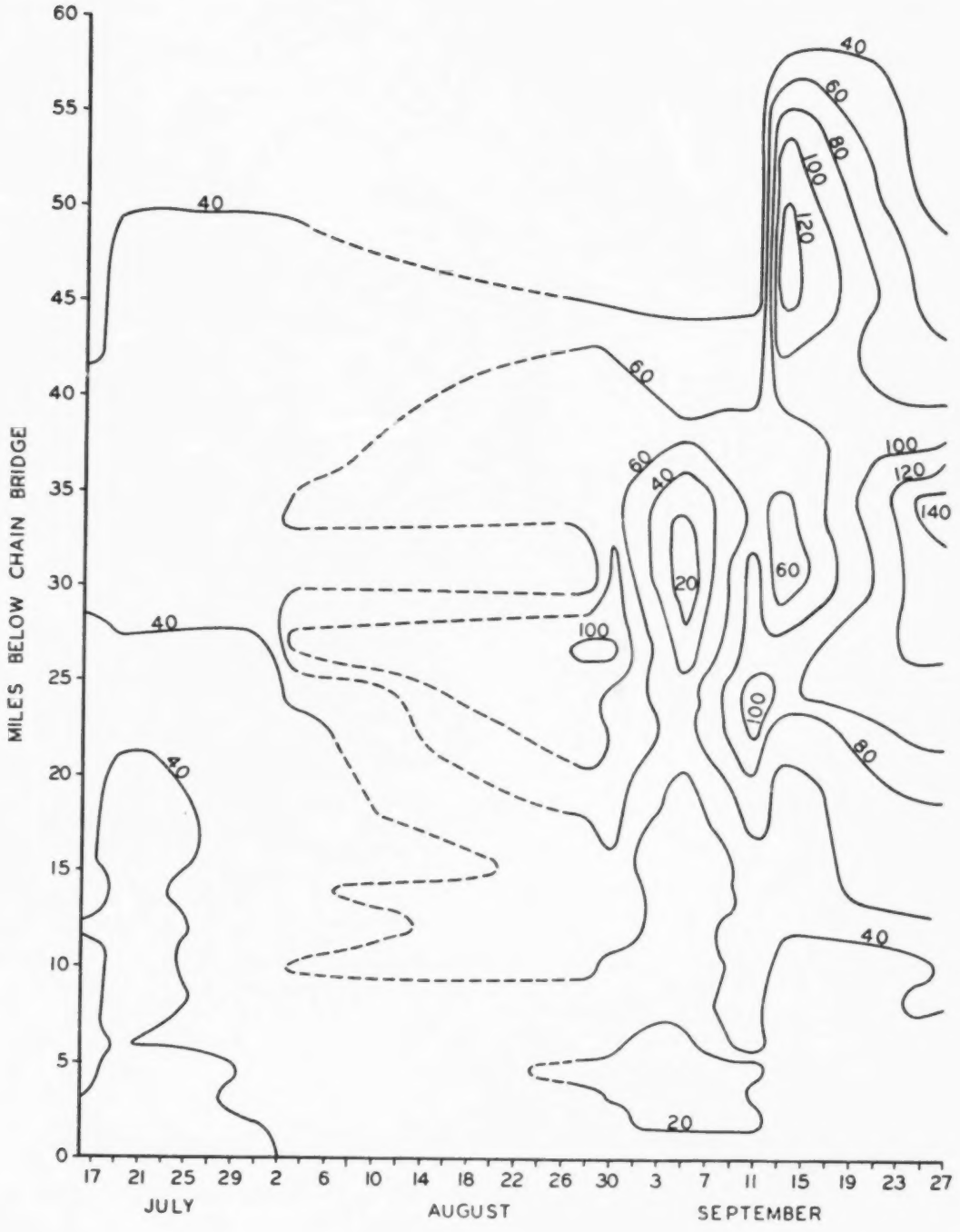
APPENDIX

DO ISOPLETH, Mg/l (SURFACE)
POTOMAC ESTUARY - 1978

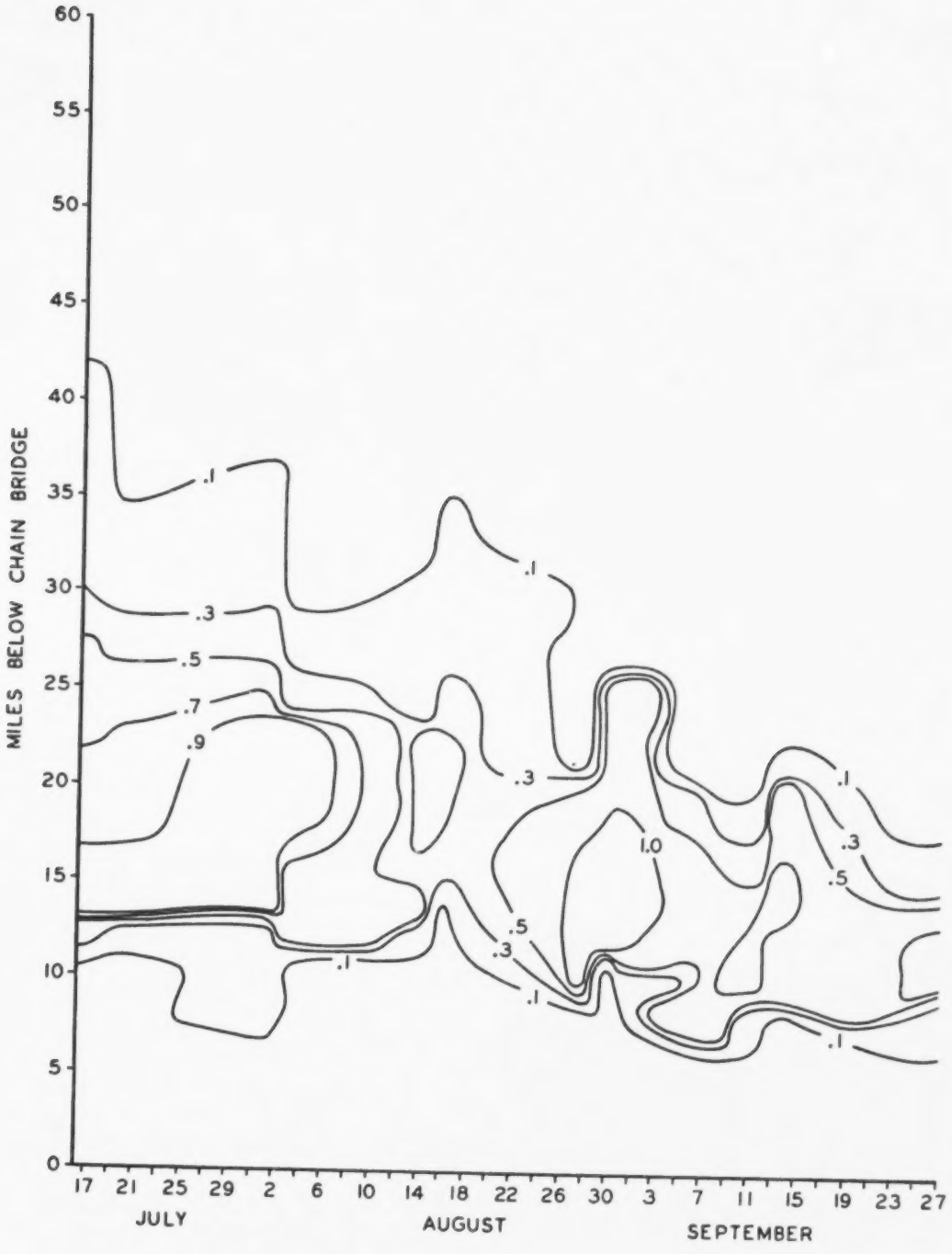



DO ISOPLETH, Mg/l (5')
POTOMAC ESTUARY - 1978
MILES BELOW CHAIN BRIDGE
60
55
50
45
40
35
30
25
20
15
10
5
0
17 21 25 29 2 6 10 14 18 22 26 30 3 7 11 15 19 23 27
JULY
AUGUST
SEPTEMBER

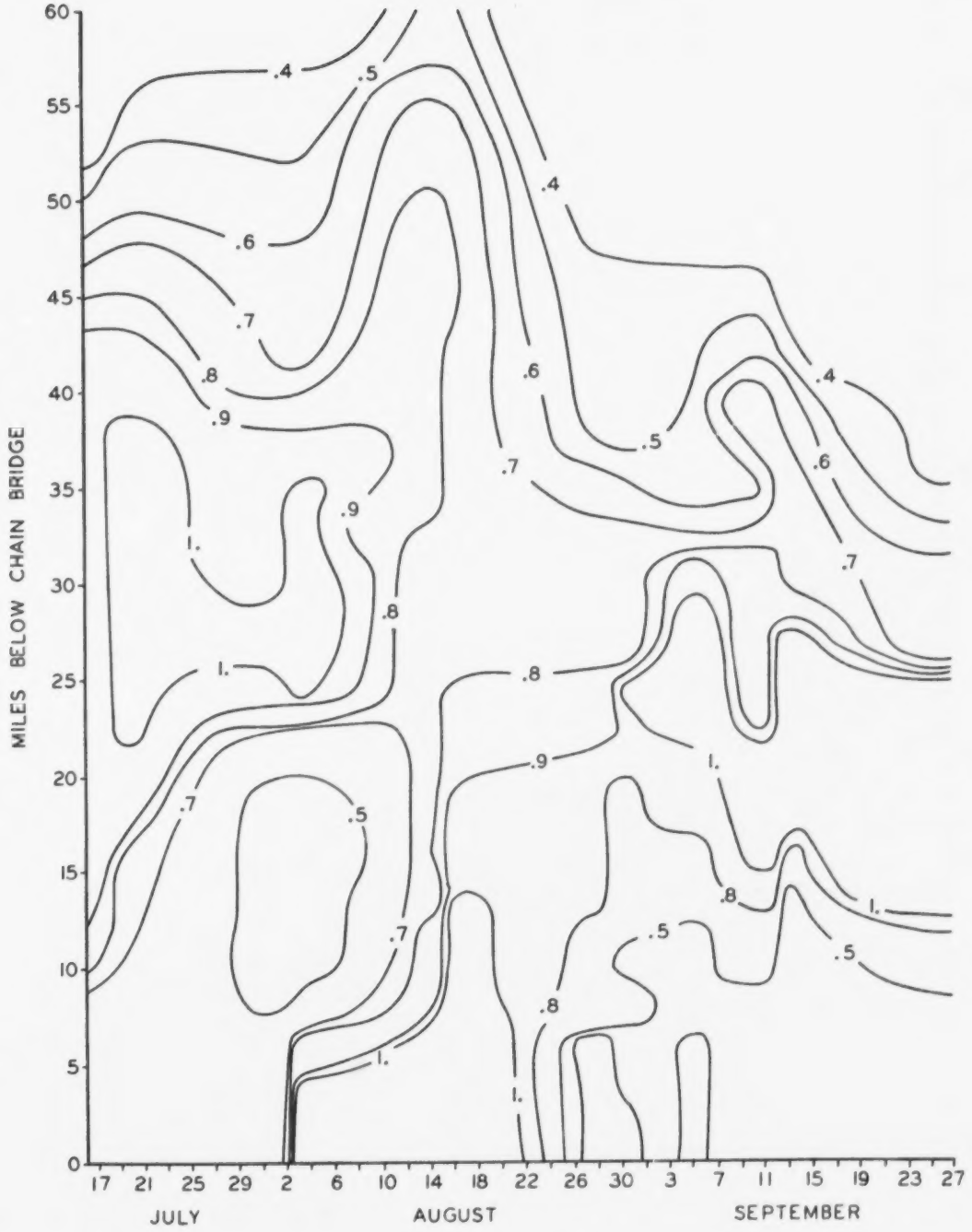
CHLOROPHYLL a ISOPLETH, µg/l
POTOMAC ESTUARY - 1978



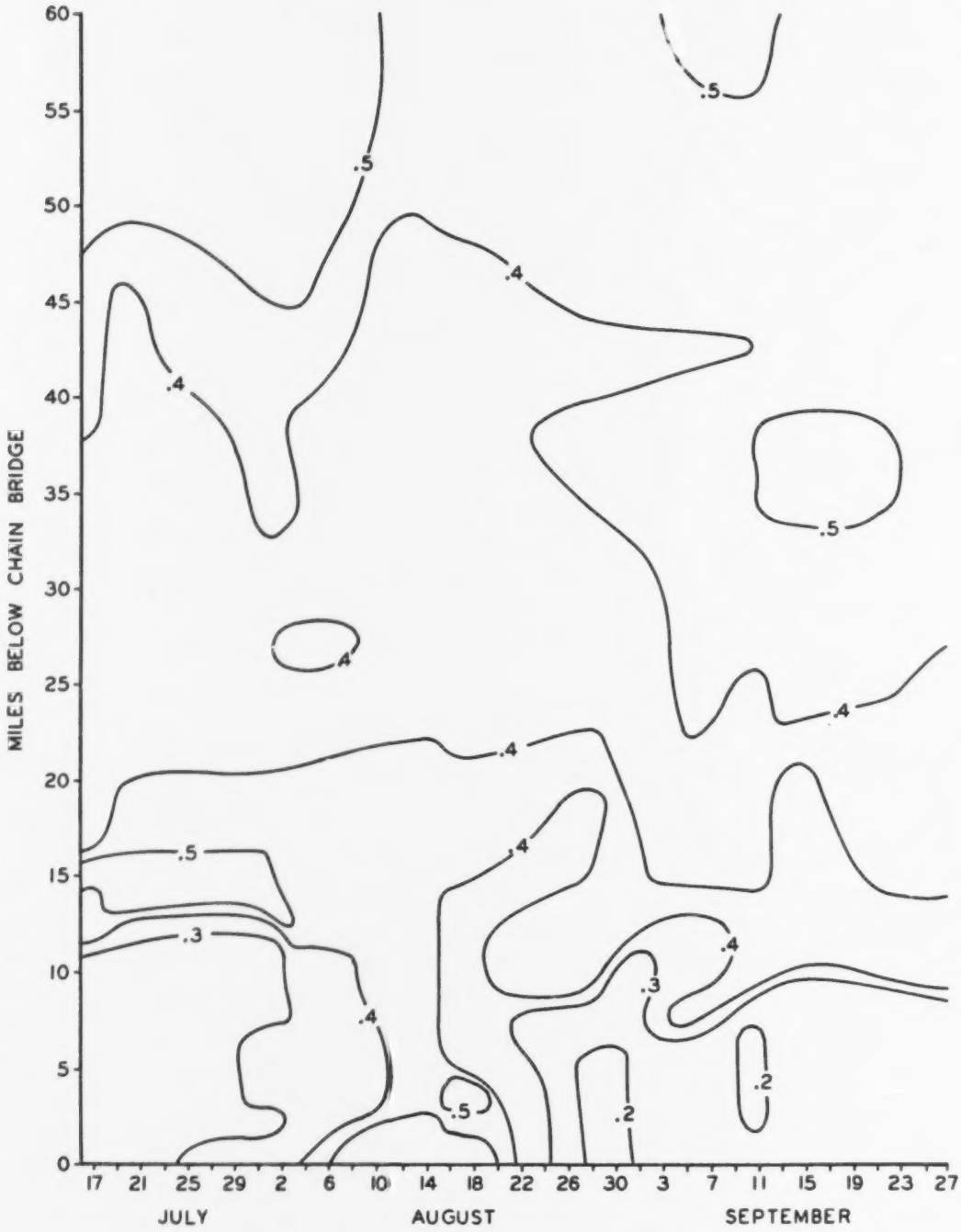
NH_3 ISOPLETH, Mg/l
POTOMAC ESTUARY - 1978



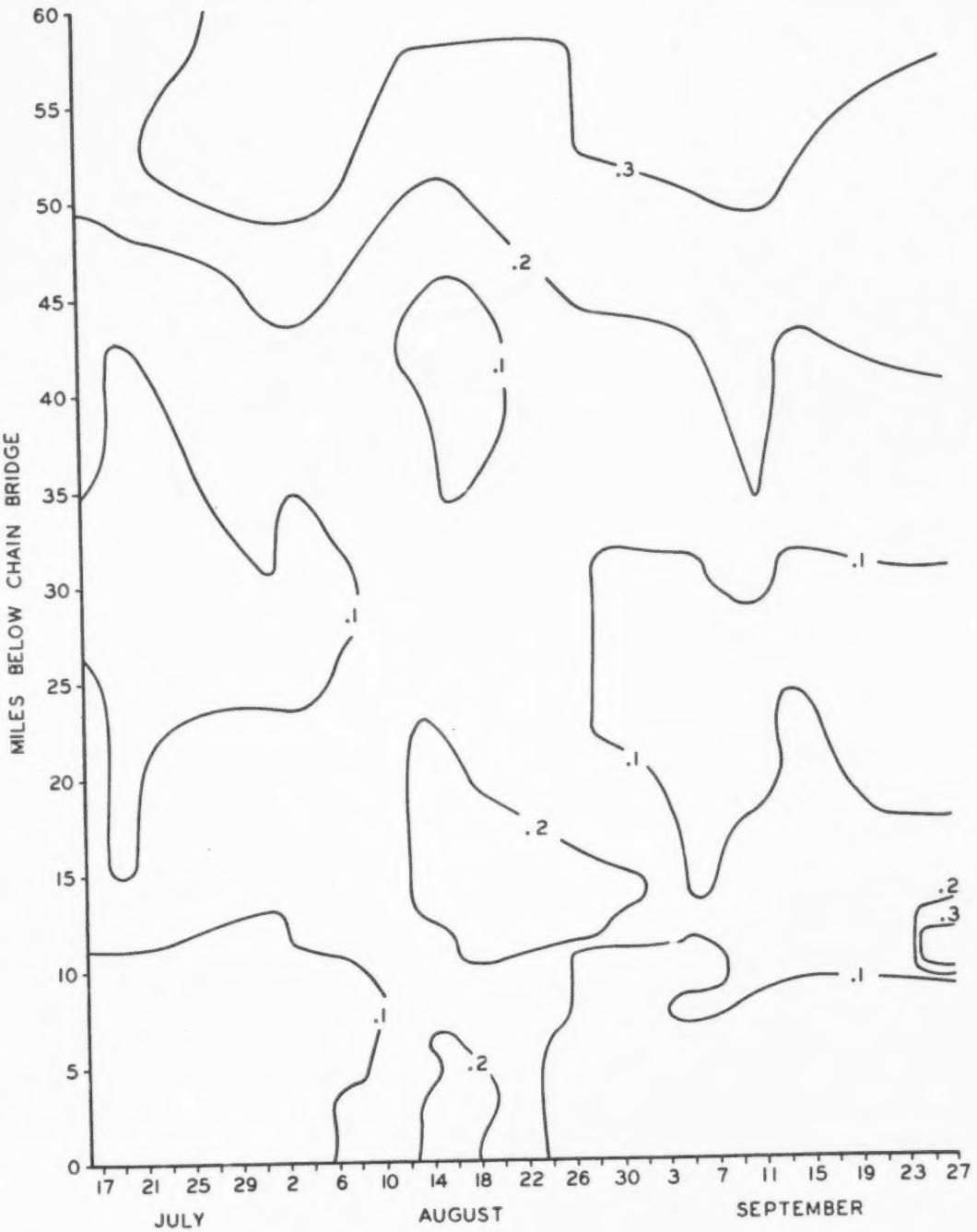
$NO_2 + NO_3$ ISOPLETH, Mg/l
POTOMAC ESTUARY - 1978

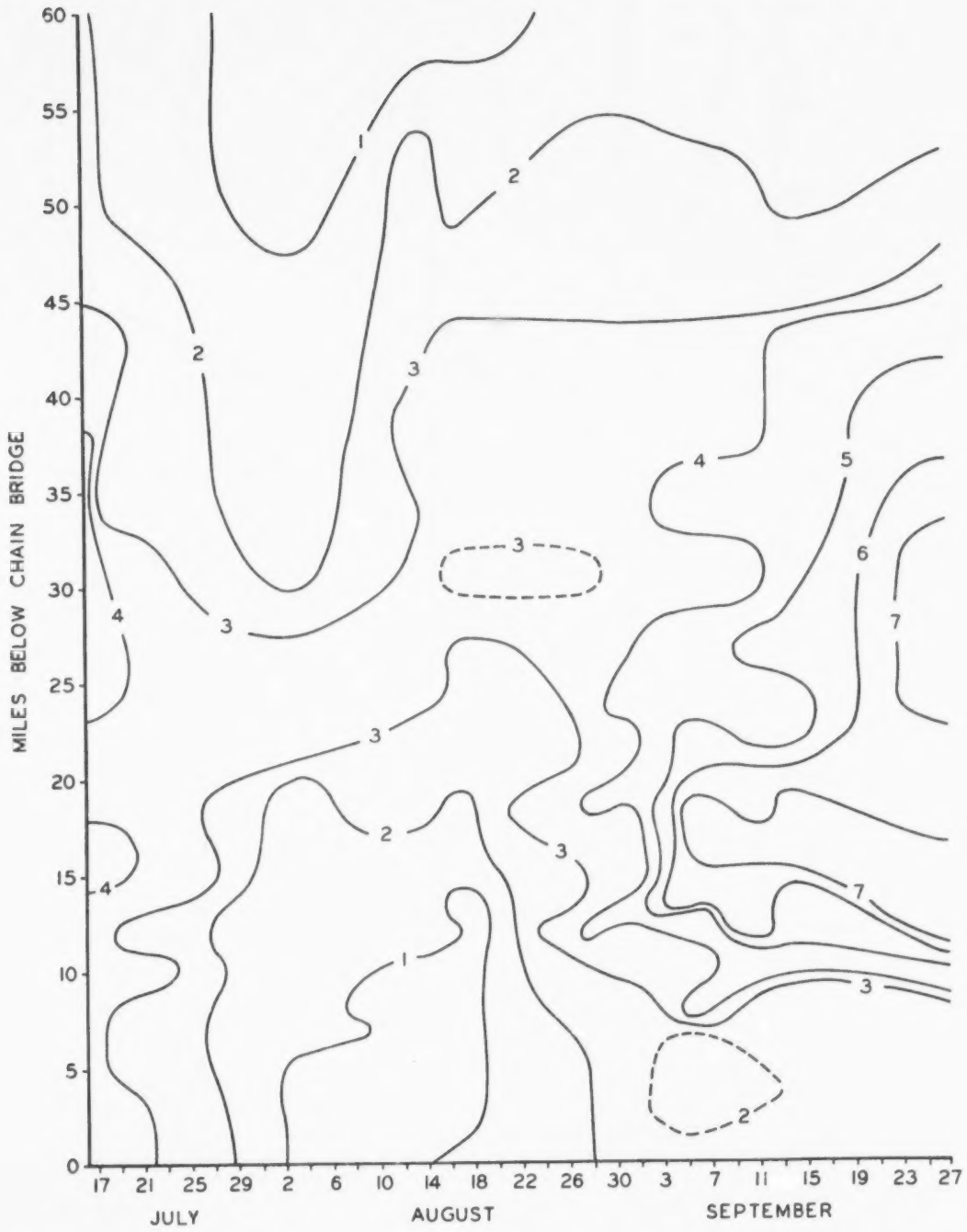


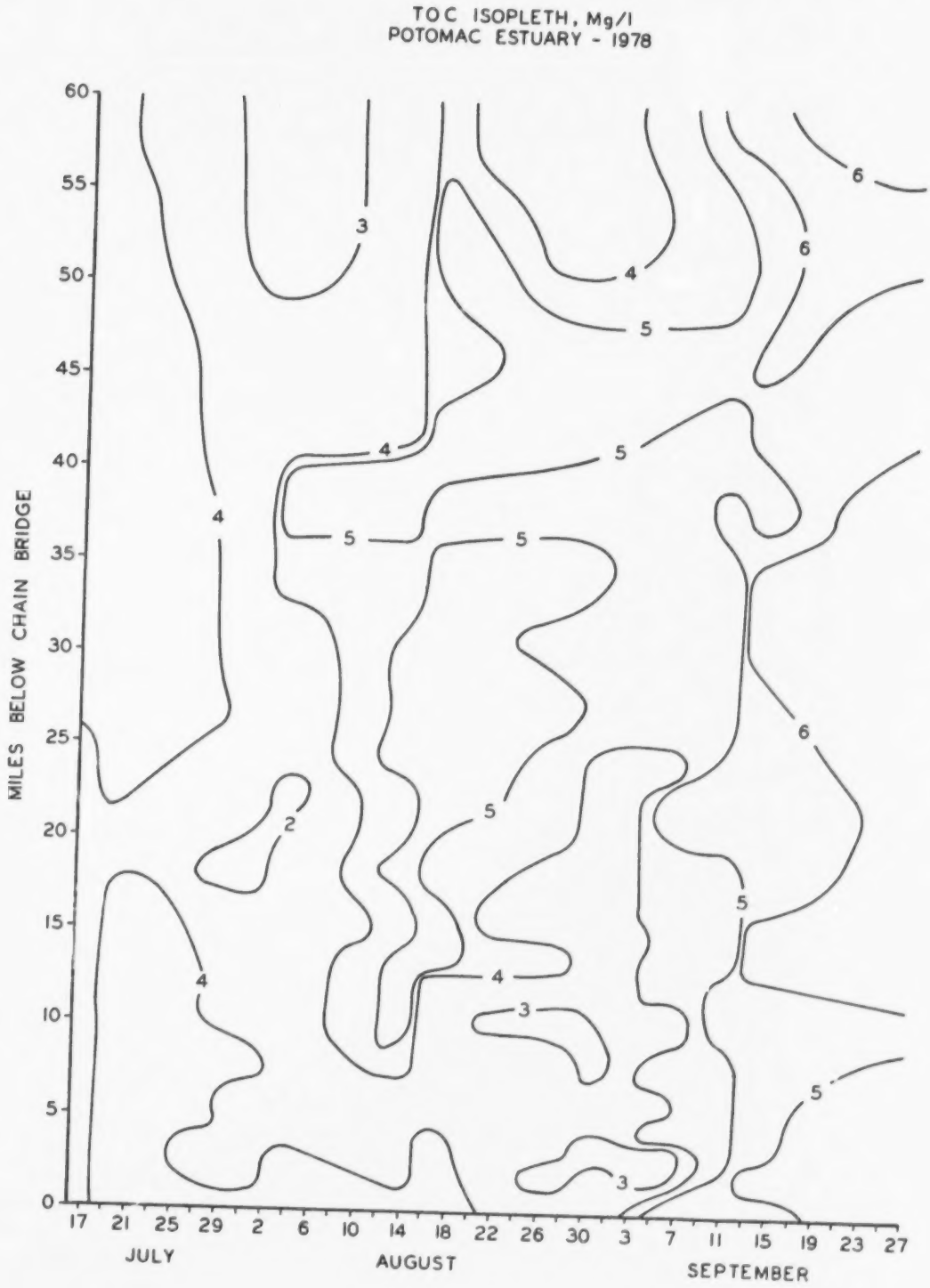
TOTAL PHOSPHORUS (as PO_4) ISOPLETH, Mg/l
POTOMAC ESTUARY - 1978



FILTERED INORGANIC PHOSPHORUS (as PO_4) ISOPLETH , Mg/l
POTOMAC ESTUARY - 1978




BOD5 ISOPLETH, Mg/l
POTOMAC ESTUARY - 1978
MILES BELOW CHAIN BRIDGE
60
55
50
45
40
35
30
25
20
15
10
5
0
17 21 25 29 2 6 10 14 18 22 26 30 3 7 11 15 19 23 27
JULY
AUGUST
SEPTEMBER


TOC ISOPLETH, Mg/l
POTOMAC ESTUARY - 1978
MILES BELOW CHAIN BRIDGE
60
55
50
45
40
35
30
25
20
15
10
5
0
17 21 25 29 2 6 10 14 18 22 26 30 3 7 11 15 19 23 27
JULY
AUGUST
SEPTEMBER
2
3
4
5
6

STATION	LOCATION	RMI (=MILES BELOW CHAIN BRIDGE)
P-B	CHAIN BRIDGE	0.0
P-4	WINDY RUN	1.9
1	KEY BRIDGE	3.4
1-A	MEMORIAL BRIDGE	4.9
2	14TH ST. bRIDGE	5.9
3	HAINS POINT	7.6
4	BELLEVUE	10.0
5	WOODROW WILSON BRIDGE	12.1
5-A	ROSIER BLUFF	13.6
6	BROAD CREEK	15.2
7	FT. WASHINGTON	16.4
8	DOGUE CREEK	22.3
8-A	GUNSTON COVE	24.3
9	CHAPMAN POINT	26.9
10	INDIAN HEAD	30.6
10-B	DEEP POINT	34.0
11	POSSUM POINT	36.0
12	SANDY POINT	42.5
13	SMITH POINT	45.8
14	MARYLAND POINT	52.4
15	NANJEMOY CREEK	58.6
15-A	MATHIAS POINT	62.8
16	RT. 301 BRIDGE	67.4

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POTOMAC RIVER DATA FOR JULY 17, 1978

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STA.	RMI	TEMP (C)	TURB	SECCHI (IN)	PH	SALIN (PPT)	COND	TOC (MG/L)		TOCF	TKN (MG/L)		TKNF	NH3 (MG/L)	NO2NO3	TPO4 (MG/L)	TPO4F	PI	CHLORO (UG/L)	BOD5 (MG/L)	BOD20	DO	DO(5) (MG/L)
P8	0.0	****	9.5	****	****	*****	*****	3.30	3.30		0.45	0.45		0.06	0.60	0.21	0.04	0.04	31.5	****	****	8.26	*****
P4	1.9	25.9	7.5	32.0	8.3	0.15	0.39	2.80	2.60		0.25	0.22		0.04	0.59	0.23	0.04	0.04	45.0	****	****	8.29	8.16
1	3.4	26.6	9.2	32.0	8.4	0.15	0.40	3.10	2.70		0.29	0.22		0.03	0.54	0.20	0.04	0.04	40.5	****	****	8.37	7.97
1A	4.9	27.2	8.5	26.0	8.3	0.13	0.41	3.50	3.00		0.23	0.23		0.02	0.56	0.20	0.04	0.04	33.0	****	****	8.28	7.24
2	5.9	26.9	10.3	20.0	8.2	0.19	0.36	3.50	3.50		0.26	0.24		0.02	0.60	0.23	0.04	0.04	33.0	****	****	7.94	7.69
3	7.6	26.6	10.0	22.0	8.2	0.15	0.34	2.80	2.20		0.27	0.27		0.03	0.66	0.25	0.04	0.04	34.5	****	****	7.33	7.33
4	10.0	26.4	10.2	26.0	8.0	0.16	0.39	3.80	2.60		0.32	0.31		0.06	0.77	0.24	0.04	0.04	28.5	****	****	7.41	7.62
5	12.1	26.3	10.5	20.0	7.8	0.14	0.36	3.90	3.10		0.71	0.64		0.40	0.69	0.43	0.13	0.12	43.5	3.7	****	7.72	7.68
5A	13.6	27.1	9.9	24.0	7.4	0.15	0.37	3.50	3.30		1.60	1.48		1.22	0.90	0.49	0.17	0.15	28.5	****	****	6.95	6.79
6	15.2	27.0	13.9	23.0	7.4	0.17	0.37	3.50	3.20		1.24	1.12		0.86	0.91	0.53	0.19	0.16	39.7	****	****	6.73	6.77
7	18.4	26.3	10.5	22.0	7.5	0.13	0.37	3.70	3.10		1.15	1.08		0.77	0.98	0.21	0.15	0.13	33.0	3.8	****	6.67	7.00
8	22.3	26.4	7.8	28.0	7.3	0.17	0.47	3.80	3.50		1.14	1.05		0.69	0.95	0.16	0.13	0.12	28.5	****	****	6.04	6.28
8A	24.3	26.5	8.5	27.0	7.3	0.14	0.36	3.30	2.90		1.04	1.03		0.65	0.97	0.36	0.11	0.11	33.0	4.1	****	6.20	5.88
9	26.9	26.5	5.5	27.0	7.4	0.13	0.36	4.40	4.40		0.93	0.93		0.59	0.96	0.32	0.09	0.09	34.5	****	****	6.34	5.99
10	30.6	26.1	10.0	28.0	7.6	0.15	0.38	4.20	3.70		0.69	0.65		0.29	0.90	0.38	0.09	0.06	49.5	4.6	****	7.33	7.43
10B	34.0	26.1	10.0	28.0	7.5	0.15	0.39	3.80	3.40		0.54	0.54		0.20	0.98	0.36	0.09	0.08	27.0	****	****	7.16	6.64
11	38.0	25.8	9.5	26.0	7.8	0.21	0.39	4.40	3.50		0.55	0.55		0.55	0.95	0.46	0.46	0.44	43.5	4.0	****	7.93	7.56
12	42.5	25.9	8.5	32.0	7.7	0.19	0.42	4.30	2.80		0.52	0.52		0.07	0.95	0.42	0.14	0.13	39.0	****	****	6.20	6.59
13	45.8	25.8	9.8	30.0	8.0	0.19	0.38	3.40	3.10		0.40	0.40		0.04	0.74	0.46	0.18	0.17	22.5	****	****	7.25	7.11
14	52.4	25.6	19.9	14.0	8.0	1.54	0.72	3.40	3.00		0.39	0.38		0.05	0.39	0.72	0.26	0.26	27.0	2.3	****	6.15	6.40
15	58.6	25.5	29.9	15.0	7.6	1.46	2.65	3.40	2.60		0.25	0.25		0.05	0.29	0.61	0.26	0.26	10.5	****	****	5.12	5.16
15A	62.8	25.0	20.4	18.0	7.4	3.48	4.81	3.80	3.30		0.29	0.26		0.05	0.24	0.45	0.22	0.22	6.0	****	****	4.43	4.84
16	67.4	25.2	15.0	20.0	7.3	3.54	6.06	3.10	2.70		0.27	0.22		0.05	0.14	0.43	0.21	0.21	12.0	1.5	****	4.71	5.08

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POTOMAC RIVER DATA FOR JULY 19, 1978

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STA.	RMI	TEMP (C)	TURB	SECCHI (IN)	PH	SALIN (PPT)	COND	TOC (MG/L)	TOCF	TKN (MG/L)	TKNF	NH3 (MG/L)	NO2NO3	TPO4 (MG/L)	TPO4F	PI	CHLORO (UG/L)	BOD5 (MG/L)	BOD20	DO	DO(5) (MG/L)
P8	0.0	****	8.8	****	****	*****	*****	4.78	3.74	0.49	0.28	0.04	0.73	0.24	0.06	0.04	52.5	3.7	****	8.51	*****
P4	1.9	27.0	6.5	30.0	8.9	*****	*****	4.68	2.59	0.28	0.16	0.02	0.69	0.22	0.04	0.04	46.5	3.4	****	9.82	10.00
1	3.4	27.0	6.5	30.0	8.8	*****	*****	4.47	3.53	0.41	0.14	0.02	0.68	0.18	0.04	0.04	45.0	3.3	****	9.46	9.58
1A	4.9	27.0	6.5	30.0	8.9	*****	*****	4.68	3.01	0.36	0.19	0.02	0.70	0.20	0.05	0.04	55.5	2.9	****	11.45	11.37
2	5.9	27.0	8.3	24.0	8.8	*****	*****	4.99	3.53	0.32	0.17	0.02	0.76	****	0.06	0.04	40.5	2.8	****	10.26	10.24
3	7.6	27.2	7.2	24.0	8.8	*****	*****	4.26	2.70	0.34	0.14	0.02	0.68	0.20	0.04	0.04	48.0	2.8	****	10.78	10.78
4	10.0	27.0	9.9	18.0	8.7	*****	*****	5.83	3.53	0.35	0.19	0.02	0.67	0.25	0.05	0.04	52.5	3.6	****	10.04	10.11
5	12.1	27.0	9.9	18.0	8.6	*****	*****	5.62	3.22	0.55	0.40	0.21	0.72	0.36	0.08	0.11	51.0	2.8	****	9.30	9.05
5A	13.6	27.0	10.0	18.0	8.1	*****	*****	4.89	3.74	1.11	0.86	0.95	0.76	0.53	0.17	0.12	43.5	3.3	****	7.91	7.77
6	15.2	27.0	9.9	24.0	7.9	*****	*****	4.89	3.53	1.33	1.09	0.85	0.79	0.54	0.18	0.09	60.7	4.7	****	7.71	7.63
7	18.4	26.8	10.2	24.0	7.8	*****	*****	3.95	3.95	1.17	1.02	0.77	0.97	0.44	0.13	0.09	54.0	3.9	****	7.46	7.52
8	22.3	27.0	9.8	24.0	7.9	*****	*****	4.05	3.43	1.13	1.01	0.72	1.04	0.28	0.16	0.04	37.5	3.7	****	7.59	7.44
8A	24.3	27.0	8.5	24.0	8.0	*****	*****	4.37	3.22	0.96	0.90	0.51	1.07	0.36	0.06	0.06	46.5	4.0	****	8.47	8.54
9	26.9	27.0	9.5	24.0	8.0	*****	*****	5.41	4.47	0.89	0.79	0.46	1.07	0.34	0.06	0.05	37.5	4.1	****	8.39	8.34
10	30.6	26.8	8.5	22.0	8.4	*****	*****	6.56	3.64	0.65	0.45	0.15	1.01	0.30	0.05	0.03	64.5	3.7	****	9.75	9.75
10B	34.0	27.0	8.9	24.0	8.3	*****	*****	5.10	5.10	0.55	0.45	0.14	1.04	0.34	0.06	0.04	7.5	2.6	****	8.95	8.83
11	38.0	26.2	6.9	24.0	8.4	*****	*****	5.73	4.05	0.38	0.33	0.03	1.00	0.35	0.08	0.08	21.0	2.6	****	9.33	9.22
12	42.5	24.0	7.9	24.0	8.5	*****	*****	4.47	3.01	0.36	0.29	0.02	0.95	0.38	0.10	0.10	55.5	3.1	****	9.16	8.95
13	45.8	27.5	6.0	26.0	8.6	0.18	0.40	5.10	4.47	0.34	0.26	0.02	0.77	0.40	0.13	0.12	52.5	2.6	****	9.34	9.38
14	52.4	27.0	14.9	12.0	8.0	0.46	0.84	4.58	3.53	0.29	0.26	0.03	0.53	0.59	0.27	0.27	30.0	1.3	****	6.25	6.13
15	56.6	26.9	18.0	12.0	7.6	1.62	2.96	4.05	3.64	0.24	0.19	0.04	0.31	0.52	0.25	0.25	9.0	1.5	****	5.01	5.00
15A	62.8	26.5	25.0	14.0	7.4	3.30	5.84	3.22	3.22	0.17	0.17	0.05	0.20	0.51	0.22	0.22	9.0	0.8	****	4.52	4.43
16	67.4	26.5	14.0	20.0	7.1	3.70	6.50	4.26	3.32	0.17	0.17	0.03	0.17	0.43	0.22	0.22	15.0	1.2	****	5.41	5.16

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POTOMAC RIVER DATA FOR AUGUST 1, 1976

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STA.	RMI	TEMP (C)	TURB	SECCHI (IN)	PH	SALIN (PPT)	COND	TOC (MG/L)	TOCF	TKN (MG/L)	TKNF	NH3 (MG/L)	NO2NO3	TPO4 (MG/L)	TPO4F	PI	CHLORO (UG/L)	BOD5 (MG/L)	BOD20	DO	DO(5) (MG/L)
P8	0.0	****	28.0	****	****	*****	*****	6.22	1.04	0.47	0.20	0.04	0.27	0.87	0.04	0.04	43.2	****	****	7.19	*****
P4	1.9	26.9	10.2	11.0	7.7	0.32	0.86	3.03	1.00	0.34	0.20	0.02	0.31	0.28	0.04	0.04	40.5	****	****	7.62	7.44
1	3.4	26.9	14.0	9.0	7.7	0.30	0.60	2.41	1.00	0.28	0.20	0.02	0.25	0.32	0.04	0.04	37.5	****	****	7.39	6.96
1A	4.9	27.0	18.0	11.0	7.7	0.26	0.63	3.92	1.00	0.25	0.20	0.02	0.22	0.32	0.04	0.04	39.0	****	****	7.77	7.35
2	5.9	27.3	19.9	12.0	7.7	0.33	0.62	3.59	1.32	0.25	0.20	0.02	0.19	0.31	0.04	0.04	36.0	****	****	8.11	7.09
3	7.6	28.4	9.9	19.0	7.8	0.30	0.65	4.59	1.00	0.62	0.47	0.36	0.50	0.58	0.09	0.06	33.0	****	****	5.48	6.54
4	10.0	28.2	8.5	14.0	7.5	0.34	0.65	2.35	1.00	0.38	0.20	0.18	0.36	0.23	0.04	0.04	22.5	****	****	6.68	5.98
5	12.1	28.9	7.5	20.0	7.7	0.28	0.65	3.59	1.00	0.38	0.20	0.18	0.35	0.29	0.06	0.04	31.5	****	****	5.87	5.90
5A	13.6	27.9	8.5	18.0	7.3	0.32	0.68	2.80	1.16	1.53	1.30	1.30	0.38	0.50	0.19	0.17	25.5	****	****	5.20	5.10
6	15.2	27.9	6.9	20.0	7.3	0.30	0.65	3.25	1.00	1.36	1.25	1.13	0.37	0.50	0.21	0.19	24.7	****	****	5.28	4.78
7	18.4	27.6	10.5	14.0	7.3	0.28	0.65	2.24	1.00	1.59	1.48	1.21	0.44	0.41	0.16	0.16	25.5	****	****	4.81	4.52
8	22.3	27.9	9.5	22.0	7.3	0.30	0.65	3.31	1.00	1.47	1.47	1.24	0.61	0.38	0.15	0.13	27.0	****	****	4.63	4.59
8A	24.3	28.0	10.0	19.0	7.2	0.31	0.68	3.64	1.00	1.12	0.06	0.74	0.96	0.38	0.13	0.10	36.0	****	****	4.79	4.89
9	26.9	28.0	9.0	20.0	7.3	0.35	0.65	3.92	1.00	0.89	0.77	0.47	1.08	0.40	0.13	0.10	40.5	****	****	4.69	4.71
10	30.6	27.9	10.0	18.0	7.5	0.28	0.61	3.31	1.00	0.86	0.48	0.18	0.97	0.39	0.11	0.10	57.0	****	****	5.53	5.49
10B	34.0	27.7	10.5	14.0	7.4	0.29	0.53	3.67	1.00	0.64	0.38	0.16	0.93	0.41	0.13	0.11	43.5	****	****	5.85	5.77
11	38.0	27.6	9.9	14.0	7.6	0.25	0.49	3.59	1.00	0.50	0.28	0.08	0.90	0.42	0.14	0.13	54.0	****	****	6.21	6.02
12	42.5	****	****	****	****	*****	*****	*****	****	****	****	****	****	****	****	****	*****	****	****	*****	*****
13	45.8	****	****	****	****	*****	*****	*****	****	****	****	****	****	****	****	****	*****	****	****	*****	*****
14	52.4	****	****	****	****	*****	*****	*****	****	****	****	****	****	****	****	****	*****	****	****	*****	*****
15	58.6	****	****	****	****	*****	*****	*****	****	****	****	****	****	****	****	****	*****	****	****	*****	*****
15A	62.8	****	****	****	****	*****	*****	*****	****	****	****	****	****	****	****	****	*****	****	****	*****	*****
16	67.4	****	****	****	****	*****	*****	*****	****	****	****	****	****	****	****	****	*****	****	****	*****	*****

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POTOMAC RIVER DATA FOR AUGUST 3, 1978

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STA.	RMI	TEMP (C)	TURB	SECCHI (IN)	PH	SALIN (PPT)	COND	TOC	TOCF	TKN	TKNF	NH3	NO2NO3	TPO4	TPO4F (MG/L)	PI	CHLORO (UG/L)	BOD5	BOD20 (MG/L)	DO	DO(S) (MG/L)
P8	0.0	****	25.0	****	****	*****	*****	3.78	1.00	0.50	0.36	0.09	1.08	0.37	0.20	0.12	24.0	0.9	****	7.73	*****
P4	1.9	****	14.0	12.0	7.6	*****	*****	5.13	1.00	0.45	0.34	0.07	1.09	0.33	0.20	0.12	25.5	0.7	****	7.62	7.52
1	3.4	26.4	15.0	18.0	7.6	*****	0.52	4.00	1.15	0.39	0.34	0.08	1.06	0.33	0.19	0.12	22.5	0.6	****	7.45	7.48
1A	4.9	26.7	14.0	22.0	7.7	*****	0.50	3.68	1.00	0.36	0.25	0.06	0.88	0.30	0.13	0.06	28.5	0.8	****	7.35	7.52
2	5.9	27.0	9.9	22.0	7.9	*****	0.56	3.19	1.00	0.34	0.20	0.04	0.83	0.25	0.11	0.04	45.0	1.2	****	7.93	7.86
3	7.6	26.6	15.0	20.0	7.6	*****	0.60	3.03	1.00	0.39	0.20	0.07	0.60	0.32	0.12	0.04	33.0	1.1	****	6.89	7.07
4	10.0	26.9	15.0	22.0	7.6	*****	0.60	3.51	1.00	0.34	0.20	0.08	0.44	0.32	0.10	0.04	40.5	1.3	****	6.71	6.81
5	12.1	27.5	14.9	22.0	7.4	*****	0.60	3.41	3.19	1.01	0.64	0.64	0.38	0.50	0.22	0.14	36.0	1.5	****	5.98	6.18
5A	13.6	27.6	15.0	24.0	7.5	0.20	0.53	3.24	1.00	0.98	0.70	0.65	0.34	0.46	0.19	0.12	37.5	1.4	****	5.74	5.82
6	15.2	27.6	9.9	26.0	7.3	0.25	0.60	3.46	1.00	1.02	0.76	0.69	0.21	0.43	0.18	0.14	31.5	1.2	****	5.26	5.11
7	18.4	27.8	5.8	24.0	7.3	0.30	0.60	3.30	1.00	1.26	1.03	1.01	0.37	0.41	0.19	0.13	31.5	1.5	****	4.81	4.76
8	22.3	27.8	6.5	26.0	7.4	0.30	0.61	2.60	1.00	1.38	1.12	1.12	0.54	0.37	0.19	0.12	36.0	3.4	****	4.52	4.50
8A	24.3	28.0	7.0	26.0	7.2	0.38	0.65	3.78	1.00	1.06	0.87	0.59	1.16	0.38	0.16	0.09	43.5	3.5	****	3.99	4.39
9	26.9	28.1	8.0	26.0	7.3	0.30	0.60	3.68	1.47	0.88	0.50	0.23	1.24	0.43	0.16	0.08	82.5	3.1	****	5.46	5.12
10	30.6	28.3	7.5	32.0	7.4	0.20	0.61	3.41	1.00	0.59	0.34	0.04	1.35	0.38	0.14	0.06	55.2	1.9	****	5.26	5.50
10B	34.0	28.1	7.0	24.0	****	0.21	0.58	4.27	1.00	0.57	0.29	0.04	1.08	0.40	0.14	0.08	63.0	1.6	****	5.55	5.77
11	38.0	27.5	9.9	23.0	7.6	0.90	0.53	6.42	1.15	0.54	0.27	0.06	0.90	0.39	0.18	0.11	52.5	1.4	****	6.18	6.34
12	42.5	28.0	9.5	24.0	7.8	0.90	0.60	3.14	1.00	0.45	0.20	0.04	0.67	0.46	0.25	0.19	46.5	1.1	****	6.11	6.11
13	45.8	28.1	9.0	23.0	7.8	1.10	0.62	3.57	1.00	0.39	0.20	0.05	0.64	0.51	0.27	0.23	51.0	1.1	****	5.86	5.95
14	52.4	28.0	9.5	18.0	7.6	0.90	1.70	2.54	1.00	0.29	0.20	0.04	0.49	0.64	0.42	0.36	27.0	0.5	****	5.68	5.33
15	58.6	27.8	9.8	22.0	7.5	4.10	4.78	2.87	1.00	0.25	0.20	0.04	0.31	0.54	0.39	0.34	28.5	0.6	****	4.78	5.03
15A	62.8	27.5	10.0	20.0	7.3	4.70	7.40	2.54	2.49	0.24	0.20	0.04	0.20	0.54	0.36	0.32	25.5	0.7	****	3.99	4.17
16	67.4	27.2	5.3	32.0	7.2	4.73	8.40	2.87	1.00	0.20	0.20	0.04	0.14	0.46	0.34	0.29	27.0	0.8	****	5.26	5.10

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POTOMAC RIVER DATA FOR AUGUST 14, 1978

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STA.	RMI	TEMP (C)	TURB	SECCHI (IN)	PH	SALIN (PPT)	COND	TOC (MG/L)	TOCF	TKN (MG/L)	TKNF	NH3 (MG/L)	NO2NO3	TPO4 (MG/L)	TPO4F	PI	CHLORO (UG/L)	BOD5 (MG/L)	BOD20	DO	DO(S) (MG/L)
P8	0.0	****	35.0	****	****	*****	*****	5.99	1.30	0.30	0.23	0.04	1.08	0.67	0.22	0.20	*****	****	****	8.35	*****
P4	1.9	26.0	40.0	6.0	7.6	*****	0.54	3.40	1.00	0.20	0.20	0.04	1.07	0.52	0.22	0.21	*****	****	****	8.41	8.39
1	3.4	26.1	25.0	10.0	7.8	*****	0.52	3.27	1.00	0.20	0.20	0.04	1.08	0.42	0.23	0.21	*****	****	****	8.38	8.38
1A	4.9	26.1	30.0	12.0	7.7	*****	0.54	3.83	1.00	0.24	0.20	0.04	1.03	0.44	0.21	0.19	*****	****	****	8.27	8.35
2	5.9	27.5	27.0	10.0	7.9	*****	0.55	2.19	1.00	0.23	0.20	0.04	1.07	0.42	0.22	0.21	*****	****	****	8.50	8.63
3	7.6	27.2	35.0	8.0	8.0	*****	0.55	4.86	1.00	0.35	0.20	0.04	0.66	0.45	0.17	0.13	*****	****	****	7.28	7.33
4	10.0	27.2	32.0	11.0	7.6	*****	0.56	5.46	1.25	0.35	0.21	0.05	0.89	0.46	0.20	0.18	*****	****	****	7.92	7.22
5	12.1	27.7	30.0	10.0	7.5	*****	0.59	5.48	1.00	0.55	0.34	0.14	0.86	0.45	0.21	0.19	*****	2.0	3.9	6.65	6.72
5A	13.6	28.6	22.0	12.0	7.3	*****	0.30	6.05	1.93	1.06	0.97	0.85	0.75	0.43	0.28	0.25	*****	****	****	5.30	5.36
6	15.2	27.5	22.3	11.0	7.2	0.20	0.48	4.18	1.47	0.57	0.56	0.38	0.80	0.46	0.23	0.21	*****	****	****	5.76	5.99
7	18.4	27.3	25.0	12.0	7.2	0.19	0.53	5.20	4.42	0.63	0.63	0.47	0.76	0.42	0.25	0.22	*****	2.4	5.5	5.28	5.32
8	22.3	28.6	20.0	12.0	7.3	0.19	0.50	4.68	1.36	0.65	0.60	0.45	0.73	0.40	0.25	0.21	*****	****	****	4.98	5.10
8A	24.3	28.2	10.5	14.0	7.8	0.10	0.55	5.88	1.45	0.62	0.37	0.17	0.65	0.37	0.20	0.17	*****	3.8	8.9	5.88	6.18
9	26.9	28.4	12.0	15.0	7.7	0.25	0.50	5.14	1.02	0.44	0.35	0.13	0.70	0.35	0.17	0.14	*****	****	****	7.58	6.94
10	30.6	29.3	9.8	21.0	7.9	0.22	0.60	*****	1.64	0.42	0.36	0.11	0.71	0.34	0.19	0.14	*****	3.3	7.4	7.32	7.42
10B	34.0	29.2	10.0	21.0	7.9	0.30	0.60	4.57	1.00	0.35	0.28	0.04	0.62	0.33	0.15	0.12	*****	****	****	5.75	5.71
11	38.0	28.9	9.0	24.0	8.1	0.28	0.60	5.37	1.00	0.51	0.34	0.04	0.68	0.31	0.17	0.11	*****	3.9	7.6	6.39	6.84
12	42.5	29.1	10.5	24.0	8.3	0.30	0.60	3.72	1.00	0.36	0.27	0.04	0.87	0.22	0.22	0.09	*****	****	****	7.61	6.76
13	45.8	28.9	7.3	29.0	8.0	0.25	0.63	3.55	1.00	0.36	0.27	0.04	0.86	0.36	0.19	0.14	*****	****	****	6.81	6.88
14	52.4	28.9	7.5	22.0	8.2	1.36	0.60	3.55	1.00	0.29	0.22	0.04	0.78	0.43	0.24	0.21	*****	3.0	6.4	6.89	7.01
15	58.6	29.1	9.5	22.0	7.7	1.12	2.13	2.47	1.00	0.38	0.23	0.04	0.54	0.47	0.31	0.30	*****	****	****	4.89	5.22
15A	62.8	28.8	10.0	24.0	7.3	4.02	5.38	2.70	1.00	0.26	0.20	0.04	0.30	0.46	0.34	0.34	*****	****	****	4.25	4.38
16	67.4	28.1	9.9	28.0	7.4	4.00	7.40	2.08	1.00	0.21	0.20	0.04	0.23	****	0.35	0.35	*****	1.8	2.9	3.80	3.65

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POTOMAC RIVER DATA FOR AUGUST 16, 1978

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STA.	RMI	TEMP (C)	TURB	SECCHI (IN)	PH	SALIN (PPT)	COND	TOC (MG/L)	TOCF	TKN (MG/L)	TKNF	NH3 (MG/L)	NO2NO3	TPO4 (MG/L)	TPO4F	PI	CHLORO (UG/L)	BOD5 (MG/L)	BOD20	DO	DO(S) (MG/L)
P8	0.0	****	20.0	****	****	*****	*****	5.40	1.95	0.46	0.36	0.04	1.18	0.70	0.29	0.24	*****	1.6	****	7.80	8.01
P4	1.9	27.5	18.0	6.0	7.8	*****	*****	4.52	1.00	0.33	0.30	0.04	1.17	0.49	0.30	0.25	*****	0.6	****	7.87	7.87
1	3.4	27.1	20.0	8.0	7.8	*****	*****	4.30	1.45	0.37	0.31	0.04	1.17	0.59	0.32	0.27	*****	0.2	****	7.79	7.79
1A	4.9	27.7	20.5	12.0	7.8	*****	*****	3.31	1.07	0.33	0.30	0.04	1.18	0.40	0.28	0.22	*****	0.3	****	7.71	7.71
2	5.9	27.9	18.0	12.0	7.9	*****	*****	4.16	1.00	0.26	0.25	0.04	1.19	0.35	0.24	0.20	*****	0.7	****	7.92	7.79
3	7.6	28.0	20.0	10.0	7.9	*****	*****	2.10	1.00	0.24	0.24	0.04	1.18	0.34	0.21	0.18	*****	0.4	****	7.71	8.04
4	10.0	28.2	18.0	12.0	7.9	0.65	1.40	3.04	1.00	0.23	0.23	0.04	1.10	0.34	0.23	0.19	*****	0.5	****	7.74	7.99
5	12.1	28.5	18.0	13.0	7.9	0.60	1.35	3.86	1.00	0.31	0.26	0.06	1.05	0.39	0.25	0.21	*****	1.1	****	7.47	7.12
5A	13.6	27.5	25.0	11.0	****	0.62	1.32	5.45	2.08	0.30	0.30	0.06	1.04	0.38	0.25	0.21	*****	0.7	****	7.05	7.40
6	15.2	28.6	18.3	12.0	7.6	0.60	1.38	5.40	1.07	0.58	0.55	0.31	0.97	0.47	0.29	0.25	*****	1.5	****	7.09	6.65
7	18.4	28.1	18.0	12.0	7.4	0.65	1.30	4.46	1.73	0.71	0.65	0.40	0.91	0.44	0.25	0.21	*****	1.9	****	6.13	5.84
8	22.3	28.0	17.0	22.0	7.5	0.65	1.30	5.45	1.29	0.75	0.70	0.43	0.84	0.38	0.24	0.18	*****	2.2	****	5.96	5.79
8A	24.3	27.7	16.5	15.0	7.4	0.60	1.39	7.21	1.40	0.70	0.66	0.38	0.82	0.36	0.21	0.16	*****	2.3	****	4.92	6.71
9	26.9	28.1	14.0	13.0	7.5	0.56	1.30	5.84	2.83	0.66	0.54	0.27	0.77	0.38	0.20	0.14	*****	3.0	****	5.66	6.45
10	30.6	28.3	14.0	18.0	7.6	0.60	1.30	5.40	2.61	0.69	0.54	0.24	0.77	0.37	0.19	0.13	*****	2.8	****	6.39	7.47
10B	34.0	29.0	10.0	20.0	7.7	0.65	1.30	6.22	2.39	0.54	0.39	0.12	0.76	0.37	0.11	0.10	*****	3.2	****	5.55	7.53
11	38.0	28.8	9.2	22.0	7.9	0.65	1.34	3.86	3.74	0.44	0.32	0.04	0.77	0.37	0.15	0.09	*****	2.8	****	6.18	8.64
12	42.5	29.1	10.0	22.0	8.2	0.60	1.34	5.89	2.50	0.44	0.31	0.04	0.77	0.38	0.15	0.08	*****	3.2	****	7.77	7.79
13	45.8	29.1	7.0	25.0	7.7	0.70	1.38	4.74	1.67	0.45	0.31	0.04	0.81	0.36	0.17	0.10	*****	2.3	****	6.75	6.05
14	52.4	29.0	7.3	13.0	7.9	0.70	1.40	5.78	1.00	0.41	0.32	0.04	0.63	0.51	0.31	0.22	*****	1.3	****	6.44	5.24
15	58.6	27.7	10.0	13.0	7.8	1.98	3.68	4.08	1.51	0.44	0.32	0.04	0.51	0.49	0.31	0.32	*****	0.8	****	4.94	4.42
15A	62.8	28.0	10.0	18.0	7.5	4.00	7.40	4.19	1.00	0.35	0.32	0.05	0.32	0.49	0.38	0.34	*****	0.8	****	3.92	3.68
16	67.4	28.3	9.9	26.0	7.6	4.40	7.90	4.79	1.73	0.34	0.29	0.04	0.27	0.46	0.36	0.32	*****	1.4	****	5.59	5.40

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POTOMAC RIVER DATA FOR AUGUST 28, 1978

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STA.	RMI	TEMP (C)	TURB	SECCHI (IN)	PH	SALIN (PPT)	COND	TOC (MG/L)	TOCF	TKN (MG/L)	TKNF	NH3 (MG/L)	NO2NO3	TPO4 (MG/L)	TPO4F	PI	CHLORO (UG/L)	BOD5 (MG/L)	BOD20	DO	DO(5) (MG/L)
P8	0.0	****	5.5	****	****	*****	*****	3.30	1.00	0.45	0.36	0.08	0.20	0.20	****	0.04	31.5	****	****	7.88	*****
P4	1.9	28.8	6.8	****	9.0	*****	*****	2.53	1.00	0.39	0.20	0.05	0.14	0.19	0.08	0.04	54.0	****	****	10.31	*****
1	3.4	29.6	6.5	22.0	9.2	*****	*****	3.24	1.00	0.28	0.20	0.05	0.11	0.18	0.07	0.04	22.5	****	****	11.36	*****
1A	4.9	28.6	6.0	26.0	8.9	*****	*****	3.52	1.00	0.26	0.20	0.04	0.17	0.19	0.06	0.04	16.5	****	****	9.60	*****
2	5.9	28.5	6.5	26.0	9.0	*****	*****	3.30	1.00	0.39	0.20	0.05	0.20	0.20	0.08	0.04	25.5	****	****	9.52	*****
3	7.6	27.9	6.0	22.0	8.5	*****	*****	3.47	1.00	0.35	0.30	0.08	0.56	0.24	0.12	0.07	22.5	****	****	7.84	*****
4	10.0	28.2	6.5	28.0	8.0	*****	*****	2.64	1.00	1.42	1.26	1.10	0.71	0.51	0.33	0.08	42.0	****	****	7.06	*****
5	12.1	28.4	6.3	23.0	8.1	*****	*****	3.44	2.14	1.57	1.45	1.19	0.77	0.47	0.28	0.23	43.5	4.2	11.3	7.71	*****
5A	13.6	28.5	6.0	29.0	7.8	*****	*****	4.13	1.36	1.74	1.51	1.29	0.81	****	0.28	0.24	61.5	****	****	7.06	*****
6	15.2	28.3	5.5	29.0	7.9	*****	*****	2.92	1.00	1.55	1.36	1.07	0.87	0.40	0.24	0.20	42.0	****	****	7.30	*****
7	18.4	28.8	6.0	28.0	8.2	*****	*****	3.97	1.00	1.12	0.99	0.58	0.95	0.36	0.19	0.14	61.5	4.9	9.7	8.14	*****
8	22.3	28.8	8.5	24.0	8.7	*****	*****	4.41	1.00	0.53	0.42	0.06	0.66	0.41	0.14	0.10	100.5	****	****	10.24	*****
8A	24.3	28.8	6.5	21.0	8.5	*****	*****	4.46	1.00	0.56	0.44	0.09	0.87	0.32	0.14	0.10	91.5	3.4	7.8	9.50	*****
9	26.5	28.7	10.0	22.0	8.6	*****	*****	5.52	1.03	0.48	0.31	0.04	0.72	0.38	0.14	0.10	106.5	****	****	9.75	*****
10	30.6	28.5	9.9	24.0	8.3	*****	*****	4.41	1.00	0.52	0.33	0.08	0.79	0.37	0.14	0.10	48.0	2.8	6.6	8.12	*****
10B	34.0	28.1	7.3	24.0	8.2	*****	0.32	5.80	1.00	0.48	0.33	0.06	0.69	0.40	0.15	0.11	78.0	****	****	7.88	*****
11	38.0	28.5	10.0	24.0	8.6	*****	0.26	4.19	1.00	0.50	0.29	0.05	0.47	0.42	0.16	0.12	78.0	3.2	7.7	8.80	*****
12	42.5	28.4	8.0	21.0	8.7	0.16	0.33	5.41	1.00	0.42	0.28	0.06	0.44	0.38	0.20	0.14	61.5	****	****	9.04	*****
13	45.8	28.4	6.0	24.0	8.7	0.34	0.72	5.35	1.00	0.39	0.28	0.07	0.41	0.43	0.26	0.23	30.0	****	****	8.89	*****
14	52.4	28.0	9.0	24.0	8.1	2.32	4.21	3.52	1.00	0.33	0.27	0.08	0.24	0.46	0.32	0.30	31.5	2.4	4.0	5.95	*****
15	58.6	28.3	7.0	22.0	7.8	3.63	6.60	3.14	1.00	0.30	0.24	0.06	0.18	0.45	0.34	0.31	25.5	****	****	6.27	*****
15A	62.8	28.2	7.0	26.0	8.1	5.12	9.15	5.96	1.47	0.37	0.26	0.04	0.09	0.57	0.41	0.34	25.5	****	****	7.91	*****
16	67.4	29.7	7.0	30.0	7.3	6.40	11.86	4.24	1.00	0.30	0.24	0.04	0.04	0.48	0.36	0.33	42.0	3.0	6.0	6.10	*****

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POTOMAC RIVER DATA FOR AUGUST 30, 1978

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STA.	RMI	TEMP (C)	TURB	SECCHI (IN)	PH	SALIN (PPT)	COND	TOC (MG/L)	TOCF	TKN (MG/L)	TKNF	NH3 (MG/L)	NO2NO3	TPO4 (MG/L)	TPO4F	PI	CHLORO (UG/L)	BOD5 (MG/L)	BOD20	DO	DO(S) (MG/L)
P8	0.0	****	9.5	****	****	*****	*****	3.31	1.86	0.36	0.23	0.04	0.15	0.20	0.09	0.04	27.0	2.9	****	7.69	*****
P4	1.9	****	4.5	22.0	****	*****	*****	3.36	1.76	0.24	0.20	0.04	0.17	0.08	0.08	0.04	24.0	2.6	****	8.23	*****
1	3.4	****	4.8	20.0	****	*****	*****	2.18	1.00	0.20	0.20	0.04	0.20	0.18	0.09	0.04	19.5	2.2	****	6.98	*****
1A	4.9	****	4.0	24.0	****	*****	*****	3.73	1.00	0.20	0.20	0.04	0.21	0.17	0.09	0.04	18.0	2.1	****	7.72	*****
2	5.9	****	5.0	24.0	****	*****	*****	3.52	1.00	0.20	0.20	0.04	0.39	0.18	0.07	0.04	21.0	2.1	****	5.47	*****
3	7.6	****	7.0	19.0	****	*****	*****	2.39	1.09	0.23	0.20	0.04	0.56	0.22	0.11	0.04	37.5	2.5	****	5.66	*****
4	10.0	****	8.3	16.0	****	*****	*****	2.98	1.00	0.27	0.20	0.04	0.34	0.24	0.10	0.04	37.5	3.2	****	7.17	*****
5	12.1	****	7.8	15.0	****	*****	*****	3.47	2.11	1.74	1.52	1.39	0.55	0.50	0.24	0.19	54.0	3.6	****	6.21	*****
5A	13.6	****	7.8	16.0	****	*****	*****	3.42	1.79	2.25	1.93	1.74	0.62	0.59	0.28	0.22	54.0	4.0	****	6.01	*****
6	15.2	****	7.5	18.0	****	*****	*****	3.36	2.65	1.53	1.33	1.13	0.66	0.42	0.23	0.18	57.0	3.2	****	6.24	*****
7	18.4	****	7.8	20.0	****	*****	*****	3.73	1.15	1.62	1.39	1.13	0.74	0.42	0.21	0.14	67.5	3.9	****	6.97	*****
8	22.3	****	4.5	18.0	****	*****	*****	3.20	1.68	1.23	0.97	0.68	0.90	0.37	0.15	0.08	78.0	3.3	****	6.89	*****
8A	24.3	****	8.5	20.0	****	*****	*****	3.95	1.15	0.73	0.52	0.19	1.00	0.34	0.13	0.06	72.0	4.7	****	7.51	*****
9	26.9	****	5.0	18.0	****	*****	*****	4.49	2.04	0.46	0.24	0.04	0.75	0.34	0.11	0.04	103.5	3.9	****	10.70	*****
10	30.6	****	6.3	20.0	****	*****	*****	4.49	2.06	0.46	0.28	0.04	0.75	0.32	0.12	0.04	87.0	3.6	****	8.51	*****
10B	34.0	****	****	****	****	*****	*****	*****	****	****	****	****	****	****	****	****	*****	****	****	*****	*****
11	38.0	****	****	****	****	*****	*****	*****	****	****	****	****	****	****	****	****	*****	****	****	*****	*****
12	42.5	****	****	****	****	*****	*****	*****	****	****	****	****	****	****	****	****	*****	****	****	*****	*****
13	45.8	****	****	****	****	*****	*****	*****	****	****	****	****	****	****	****	****	*****	****	****	*****	*****
14	52.4	****	****	****	****	*****	*****	*****	****	****	****	****	****	****	****	****	*****	****	****	*****	*****
15	58.6	****	****	****	****	*****	*****	*****	****	****	****	****	****	****	****	****	*****	****	****	*****	*****
15A	62.8	****	****	****	****	*****	*****	*****	****	****	****	****	****	****	****	****	*****	****	****	*****	*****
16	67.4	****	****	****	****	*****	*****	*****	****	****	****	****	****	****	****	****	*****	****	****	*****	*****

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POTOMAC RIVER DATA FOR SEPTEMBER 5, 1978

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STA.	RMI	TEMP (C)	TURB	SECCHI (IN)	PH	SALIN (PPT)	COND	TOC (MG/L)	TOCF	TKN (MG/L)	TKNF	NH3 (MG/L)	NO2NO3	TPO4 (MG/L)	TPO4F	PI	CHLORO (UG/L)	BOD5 (MG/L)	BOD20	DO	DO(S) (MG/L)
PB	0.0	****	10.0	****	****	*****	*****	5.67	1.24	0.87	0.87	0.87	0.91	0.25	0.10	0.04	42.0	4.7	****	8.05	*****
P4	1.9	25.5	4.5	24.0	****	*****	0.44	2.12	1.00	0.24	0.21	0.04	0.87	0.24	0.14	0.07	10.5	1.3	****	8.29	*****
1	3.4	25.7	3.8	24.0	****	*****	0.45	2.03	1.00	0.22	0.22	0.87	0.85	0.24	0.16	0.07	6.0	1.7	****	8.49	*****
1A	4.9	26.0	3.8	23.0	****	*****	0.45	5.92	1.00	0.37	0.22	0.04	0.85	0.21	0.14	0.06	12.0	1.5	****	8.65	*****
2	5.9	25.8	5.3	18.0	****	*****	0.45	3.76	1.00	0.43	0.24	0.04	0.87	0.25	0.13	0.06	10.5	1.9	****	8.33	*****
3	7.6	26.3	6.5	22.0	****	*****	0.31	4.32	1.00	0.91	0.64	0.64	0.45	0.44	0.18	0.12	28.5	4.2	****	8.04	*****
4	10.0	26.3	5.5	23.0	****	*****	0.39	3.63	1.00	0.44	0.37	0.27	0.45	0.32	0.12	0.06	12.0	3.2	****	7.72	*****
5	12.1	26.3	4.5	23.0	****	*****	0.39	4.13	1.00	0.78	0.78	0.78	0.48	0.36	0.18	0.11	27.0	4.1	****	6.08	*****
5A	13.6	26.7	3.3	24.0	****	*****	0.30	4.75	1.00	0.81	0.81	0.81	0.57	0.51	0.17	0.10	21.0	6.3	****	5.96	*****
6	15.2	26.8	3.1	26.0	****	*****	0.30	4.02	1.00	0.88	0.74	0.71	0.68	0.35	0.17	0.10	16.5	6.9	****	5.96	*****
7	18.4	26.8	5.5	23.0	****	*****	0.32	4.50	1.00	0.72	0.64	0.48	0.94	0.32	0.16	0.08	30.0	7.1	****	6.41	*****
8	22.3	26.6	7.5	17.0	****	*****	0.22	5.36	1.00	0.53	0.41	0.04	1.37	0.40	0.13	0.06	52.5	5.3	****	6.52	*****
8A	24.3	26.7	9.9	18.0	****	*****	0.35	3.63	****	0.47	0.39	0.04	1.17	0.41	0.10	0.06	49.5	4.7	****	7.81	*****
9	26.9	26.9	9.5	18.0	****	*****	0.32	5.92	1.00	0.50	0.37	0.04	1.20	0.41	0.13	0.06	28.5	5.1	****	7.30	*****
10	30.6	26.7	9.5	19.0	****	*****	0.30	4.10	1.00	0.44	0.37	0.04	0.95	0.43	0.15	0.09	7.5	3.7	****	7.30	*****
10B	34.0	26.5	10.0	17.0	****	*****	0.20	4.47	1.00	0.33	0.33	0.04	0.60	0.49	0.41	0.15	22.5	4.6	****	7.70	*****
11	38.0	26.9	9.9	22.0	****	0.80	*****	3.63	1.00	0.28	0.28	0.04	0.53	0.45	0.20	0.15	62.2	3.2	****	7.28	*****
12	42.5	****	****	****	****	*****	*****	*****	****	****	****	****	****	****	****	****	*****	****	****	*****	*****
13	45.8	****	****	****	****	*****	*****	*****	****	****	****	****	****	****	****	****	*****	****	****	*****	*****
14	52.4	****	****	****	****	*****	*****	*****	****	****	****	****	****	****	****	****	*****	****	****	*****	*****
15	58.6	****	****	****	****	*****	*****	*****	****	****	****	****	****	****	****	****	*****	****	****	*****	*****
15A	62.8	****	****	****	****	*****	*****	*****	****	****	****	****	****	****	****	****	*****	****	****	*****	*****
16	67.4	****	****	****	****	*****	*****	*****	****	****	****	****	****	****	****	****	*****	****	****	*****	*****

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POTOMAC RIVER DATA FOR SEPTEMBER 11, 1978

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STA.	RMI	TEMP (C)	TURB	SECCHI (IN)	PH	SALIN (PPT)	COND	TOC (MG/L)	TOCF	TKN (MG/L)	TKNF	NH3	NO2NO3 (MG/L)	TPO4	TPO4F (MG/L)	PI	CHLORO (UG/L)	BOD5 (MG/L)	BOD20	DO	DO(5) (MG/L)
P8	0.0	26.0	8.5	****	****	*****	*****	5.93	1.00	0.54	0.53	0.08	0.42	0.27	0.12	0.06	24.0	****	****	8.17	*****
P4	1.9	27.5	5.3	21.0	8.6	*****	*****	5.91	1.20	0.30	0.25	0.04	0.26	0.19	0.08	0.04	18.0	****	****	9.82	8.48
1	3.4	27.0	6.5	26.0	8.6	*****	*****	4.07	1.00	0.31	0.26	0.04	0.26	0.19	0.08	0.04	21.0	****	****	9.94	10.13
1A	4.9	27.0	6.0	28.0	8.3	*****	*****	4.17	1.18	0.28	0.23	0.06	0.24	0.19	0.07	0.04	16.5	****	****	7.95	8.15
2	5.9	26.0	5.8	21.0	6.9	*****	*****	4.98	1.00	0.26	0.26	0.05	0.21	0.20	0.07	0.04	49.5	****	****	8.28	7.70
3	7.6	26.0	10.0	20.0	8.3	*****	*****	4.37	1.20	0.46	0.42	0.14	0.41	0.25	0.08	0.04	51.0	****	****	8.15	8.02
4	10.0	26.0	6.5	21.0	7.8	*****	*****	5.41	1.00	1.78	1.74	1.39	0.63	0.50	0.23	0.18	60.0	****	****	7.02	6.77
5	12.1	26.0	9.5	22.0	7.8	*****	*****	5.16	1.26	1.52	1.49	1.07	0.74	0.42	0.20	0.16	57.0	6.4	12.8	7.01	6.88
5A	13.6	26.0	8.5	23.0	7.6	*****	*****	4.72	1.08	1.36	1.36	0.93	0.84	0.41	0.21	0.18	45.0	****	****	5.76	5.36
6	15.2	26.0	6.5	28.0	7.8	*****	*****	4.67	1.00	0.92	0.82	0.35	1.04	0.34	0.18	0.14	55.5	****	****	6.40	6.66
7	18.4	26.0	7.5	32.0	7.7	*****	*****	3.82	2.29	0.64	0.64	0.11	1.08	0.32	0.15	0.10	66.0	4.4	7.9	6.39	5.89
8	22.3	26.0	8.0	26.0	7.5	*****	*****	8.34	6.10	0.63	0.52	0.06	0.95	0.35	0.13	0.08	100.5	****	****	7.91	7.62
8A	24.3	26.0	10.0	22.0	8.3	*****	*****	5.16	2.09	0.63	0.43	0.05	0.83	0.38	0.14	0.09	110.0	4.4	10.2	8.30	8.07
9	26.9	26.0	10.0	18.0	8.8	*****	*****	4.76	1.26	0.76	0.43	0.04	0.59	0.42	0.13	0.08	88.5	****	****	9.89	9.46
10	30.6	26.0	10.0	22.0	8.0	*****	*****	4.72	1.36	0.68	0.54	0.08	0.87	0.45	0.17	0.14	94.5	3.9	9.2	6.93	7.24
10B	34.0	26.0	12.0	20.0	8.4	*****	*****	4.57	1.06	0.65	0.40	0.07	0.59	0.50	0.23	0.20	63.0	****	****	7.59	7.57
11	38.0	26.0	11.0	20.0	8.4	*****	*****	5.36	1.11	0.49	0.41	0.06	0.43	0.50	0.24	0.21	63.0	3.6	8.2	7.45	7.78
12	42.5	27.0	9.5	24.0	8.1	*****	*****	4.42	1.11	0.45	0.38	0.07	0.37	0.40	0.23	0.21	48.0	****	****	7.20	7.25
13	45.8	26.0	7.0	34.0	8.3	*****	*****	5.23	1.53	0.45	0.34	0.05	0.23	0.46	0.30	0.28	36.0	****	****	8.28	7.75
14	52.4	26.0	6.0	35.0	7.9	*****	*****	4.47	1.16	0.31	0.24	0.05	0.14	0.44	0.31	0.31	25.5	2.0	4.5	6.97	6.73
15	58.6	26.0	9.0	30.0	7.8	*****	*****	6.35	1.94	0.34	0.31	0.05	0.10	0.57	0.37	0.36	90.0	****	****	6.54	6.51
15A	62.8	26.0	5.5	42.0	7.6	*****	*****	4.83	1.00	0.28	0.28	0.05	0.04	0.48	0.38	0.37	49.5	****	****	5.73	5.94
16	67.4	26.0	6.0	52.0	7.5	*****	*****	4.86	1.75	0.31	0.30	0.07	0.04	0.45	0.38	0.38	43.5	3.5	5.8	5.24	5.27

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POTOMAC RIVER DATA FOR SEPTEMBER 13, 1978

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STA.	RMI	TEMP (C)	TURB	SECCHI (IN)	PH	SALIN (PPT)	COND	TOC (MG/L)	TOCF	TKN (MG/L)	TKNF	NH3 (MG/L)	NO2NO3	TPO4 (MG/L)	TPO4F	PI	CHLORO (UG/L)	BOD5 (MG/L)	BOD20	DO	DO(S) (MG/L)
P8	0.0	25.0	14.0	****	****	*****	*****	6.95	3.55	0.46	0.46	0.08	0.40	0.28	0.13	0.05	39.0	2.7	****	8.11	*****
P4	1.9	25.7	11.0	18.0	8.2	*****	*****	4.94	4.68	0.40	0.37	0.07	0.39	0.26	0.10	0.04	34.5	2.7	****	7.35	6.95
1	3.4	25.9	11.0	21.0	8.2	*****	*****	5.19	3.04	0.39	0.33	0.08	0.41	0.25	0.11	0.04	33.0	2.0	****	7.43	6.75
1A	4.9	25.4	10.0	26.0	8.1	*****	*****	5.76	2.12	0.41	0.37	0.08	0.41	0.25	0.11	0.04	27.0	2.5	****	7.20	8.00
2	5.9	25.6	11.0	24.0	8.1	*****	*****	5.86	4.30	0.42	0.38	0.08	0.36	0.26	0.11	0.04	34.5	2.4	****	7.25	7.69
3	7.6	25.1	19.0	19.0	8.1	*****	*****	5.24	3.52	0.38	0.38	0.08	0.26	0.26	0.09	0.04	30.0	2.3	****	7.63	5.99
4	10.0	25.3	12.5	23.0	7.8	*****	*****	5.55	2.99	1.22	1.18	0.77	0.37	0.40	0.19	0.12	36.0	4.2	****	6.72	5.44
5	12.1	25.6	15.0	22.0	7.7	*****	*****	5.76	3.86	1.60	1.60	0.54	0.41	0.53	0.24	0.19	42.0	5.3	****	5.74	6.58
5A	13.6	25.5	14.0	23.0	7.8	*****	*****	6.42	4.88	1.78	1.60	1.16	0.46	0.49	0.22	0.16	45.0	5.2	****	6.86	5.17
6	15.2	25.5	10.5	22.0	7.6	*****	*****	6.01	4.61	2.05	2.05	1.52	0.64	0.51	0.24	0.18	51.8	7.0	****	5.86	5.01
7	18.4	25.3	9.5	25.0	7.6	*****	*****	5.04	2.87	1.27	1.24	0.63	1.07	0.42	0.20	0.14	54.0	7.6	****	5.51	6.72
8	22.3	25.7	9.2	24.0	7.6	0.23	0.47	4.37	3.50	0.72	0.64	0.10	1.23	0.38	0.17	0.11	64.5	4.7	****	6.07	6.19
8A	24.3	25.8	20.0	20.0	7.6	0.21	0.49	5.32	3.55	0.66	0.53	0.07	1.09	0.54	0.17	0.10	99.0	****	****	6.05	6.53
9	26.9	25.7	11.0	25.0	7.9	0.22	0.51	5.62	3.19	0.66	0.53	0.07	1.02	0.43	0.16	0.09	90.0	5.0	****	7.18	7.58
10	30.6	25.9	11.5	24.0	8.2	0.21	0.45	6.64	3.04	0.71	0.49	0.06	0.79	0.43	0.16	0.09	43.5	4.9	****	8.14	8.28
10B	34.0	25.7	17.0	15.0	8.3	0.14	0.42	8.00	3.99	0.71	0.49	0.07	0.76	0.53	0.18	0.12	57.0	4.5	****	7.54	6.86
11	36.0	25.8	16.5	18.0	8.3	0.20	0.42	4.42	3.45	0.63	0.43	0.07	0.68	0.55	0.23	0.18	75.0	4.6	****	7.54	7.60
12	42.5	26.1	10.0	22.0	8.3	0.20	0.41	5.70	3.76	0.56	0.41	0.07	0.42	0.46	0.24	0.20	103.5	4.3	****	7.69	6.84
13	45.8	26.1	6.5	24.0	8.1	0.84	1.62	6.06	4.51	0.59	0.47	0.07	0.30	0.44	0.26	0.22	132.0	2.2	****	7.65	7.89
14	52.4	26.0	13.0	23.0	8.0	2.26	4.10	5.09	4.03	0.50	0.47	0.07	0.17	0.51	0.33	0.31	115.5	1.6	****	7.01	7.16
15	58.6	25.9	12.5	24.0	****	4.04	7.15	6.24	4.99	0.48	0.48	0.07	0.13	0.48	0.34	0.34	24.0	1.6	****	6.60	5.59
15A	62.8	25.9	8.4	32.0	7.7	5.57	9.65	5.27	2.94	0.43	0.38	0.06	0.07	0.49	0.36	0.35	24.0	2.1	****	6.42	6.75
16	67.4	25.9	4.7	56.0	7.7	6.83	11.79	4.73	3.04	0.43	0.39	0.07	0.04	0.42	0.36	0.36	45.0	1.8	****	6.14	6.46

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POTOMAC RIVER DATA FOR SEPTEMBER 25, 1978

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STA.	RMI	TEMP (C)	TURB	SECCHI (IN)	PH	SALIN (PPT)	COND	TOC (MG/L)	TOCF	TKN (MG/L)	TKNF	NH3	NO2NO3 (MG/L)	TPO4	TPO4F (MG/L)	PI	CHLORO (UG/L)	BOD5 (MG/L)	BOD20	DO	DO(S) (MG/L)
P8	0.0	****	****	****	****	*****	*****	3.55	2.42	0.67	0.60	0.04	0.69	0.22	0.16	0.09	21.0	****	****	8.99	*****
P4	1.9	23.5	****	****	8.0	*****	*****	4.57	2.26	0.57	0.55	0.04	0.63	0.20	0.14	0.06	21.0	****	****	9.52	9.48
1	3.4	23.0	****	24.0	8.0	*****	*****	3.46	2.42	0.57	0.52	0.04	0.59	0.20	0.14	0.06	25.5	****	****	9.43	9.18
1A	4.9	23.5	****	30.0	7.9	*****	*****	4.21	2.42	0.55	0.51	0.06	0.54	0.20	0.12	0.06	25.5	****	****	8.51	8.46
2	5.9	24.0	****	24.0	7.9	*****	*****	4.13	2.42	0.57	0.52	0.09	0.54	0.20	0.12	0.05	18.0	****	****	7.70	7.86
3	7.6	24.0	****	24.0	7.8	*****	*****	4.99	2.42	0.75	0.56	0.20	0.49	0.23	0.13	0.06	42.0	****	****	7.75	7.38
4	10.0	23.5	****	24.0	7.3	*****	*****	5.05	3.98	2.33	1.71	1.60	0.61	0.64	0.43	0.41	39.0	****	****	5.70	5.59
5	12.1	24.0	****	28.0	7.5	*****	*****	6.12	3.71	1.82	1.26	1.05	0.81	0.47	0.29	0.26	54.0	7.9	12.0	6.78	6.15
5A	13.6	23.5	****	26.0	7.3	*****	*****	7.64	3.87	1.71	1.21	0.74	1.61	0.41	0.22	0.18	76.5	****	****	6.11	5.84
6	15.2	23.0	****	26.0	7.2	*****	*****	5.91	6.44	1.23	0.89	0.23	1.89	0.34	0.19	0.13	72.0	****	****	5.90	3.42
7	18.4	23.5	****	22.0	7.5	*****	*****	6.60	5.10	1.10	0.87	0.04	1.71	0.32	0.15	0.07	79.5	6.2	8.4	7.08	7.43
8	22.3	****	****	24.0	8.0	*****	*****	6.04	3.33	1.07	0.83	0.04	1.38	0.31	0.14	0.06	103.5	****	****	9.22	7.95
8A	24.3	****	****	25.0	8.2	*****	*****	6.50	3.65	0.95	0.83	0.04	1.04	0.36	0.15	0.08	111.0	7.1	10.5	9.18	8.17
9	26.9	****	****	22.0	8.5	*****	*****	8.64	3.87	0.80	0.64	0.04	0.63	0.41	0.16	0.08	126.0	****	****	10.33	9.64
10	30.6	24.0	****	22.0	8.6	0.40	0.85	8.86	3.65	0.75	0.56	0.04	0.63	0.41	0.18	0.10	133.5	7.6	11.0	10.28	9.88
10B	34.0	23.4	****	20.0	8.5	0.40	0.84	6.98	3.71	0.75	0.56	0.04	0.41	0.48	0.22	0.15	141.0	****	****	9.20	8.55
11	38.0	23.6	****	21.0	8.3	0.45	0.94	7.68	4.19	0.81	0.64	0.04	0.39	0.46	0.23	0.19	93.0	5.7	11.2	8.78	8.50
12	42.5	23.4	****	24.0	8.1	1.10	2.00	5.53	3.87	0.75	0.67	0.04	0.30	0.39	0.24	0.22	63.0	****	****	8.15	8.13
13	45.8	23.3	****	23.0	7.9	1.35	2.37	5.16	3.71	0.72	0.63	0.05	0.28	0.40	0.27	0.23	52.5	****	****	7.81	7.74
14	52.4	23.3	****	22.0	7.7	2.46	4.30	8.48	3.87	0.77	0.64	0.08	0.15	0.45	0.29	0.28	30.0	2.0	4.5	7.25	6.93
15	58.6	23.8	****	26.0	7.5	4.50	7.55	4.24	3.92	0.80	0.66	0.04	0.18	0.43	0.31	0.31	25.5	****	****	6.43	6.52
15A	62.8	23.4	****	34.0	7.5	6.22	10.30	3.96	3.87	0.75	0.64	0.04	0.17	0.42	0.31	0.31	16.5	****	****	5.84	5.76
16	67.4	24.1	****	36.0	7.1	7.40	12.30	12.40	2.85	0.72	0.69	0.07	0.14	0.39	0.30	0.30	9.0	1.4	2.9	5.13	5.09

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POTOMAC RIVER DATA FOR SEPTEMBER 27, 1978

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STA.	RMI	TEMP (C)	TURB	SECCHI (IN)	PH	SALIN (PPT)	COND	TOC (MG/L)	TOCF	TKN (MG/L)	TKNF	NH3 (MG/L)	NO2NO3	TPO4 (MG/L)	TPO4F	PI	CHLORO (UG/L)	BOD5 (MG/L)	BOD20	DO	DO(S) (MG/L)
P8	0.0	21.0	9.8	****	****	*****	*****	8.17	1.00	0.62	0.55	0.04	0.58	0.21	****	0.04	27.0	1.9	****	9.13	*****
P4	1.9	****	****	****	****	*****	*****	*****	****	****	****	****	****	****	****	****	*****	****	****	*****	*****
1	3.4	****	****	****	****	*****	*****	*****	****	****	****	****	****	****	****	****	*****	****	****	*****	*****
1A	4.9	****	****	****	****	*****	*****	*****	****	****	****	****	****	****	****	****	*****	****	****	*****	*****
2	5.9	****	****	****	****	*****	*****	*****	****	****	****	****	****	****	****	****	*****	****	****	*****	*****
3	7.6	23.1	12.0	18.5	****	0.28	0.67	5.02	1.27	0.92	0.83	0.33	0.61	0.28	0.13	0.07	39.0	3.7	****	6.55	6.87
4	10.0	24.3	9.5	21.0	****	0.25	0.66	6.31	1.45	2.08	1.66	1.44	0.75	0.54	0.29	0.29	31.5	5.3	****	6.63	6.63
5	12.1	24.0	14.5	16.0	****	0.30	0.64	10.79	1.34	1.55	1.55	0.86	1.40	0.55	0.23	0.20	64.5	8.7	****	5.89	6.04
5A	13.6	23.4	9.6	19.0	****	0.30	0.60	7.91	2.91	1.12	1.12	0.41	1.78	0.42	0.17	0.13	84.0	3.5	****	5.85	3.90
6	15.2	23.4	8.1	23.0	****	0.32	0.65	7.27	3.07	1.00	0.98	0.15	1.90	0.42	0.15	0.11	78.8	7.9	****	6.80	5.24
7	18.4	23.5	8.0	20.5	****	0.25	0.60	6.68	1.94	0.92	0.92	0.04	1.69	0.31	0.11	0.06	73.5	5.0	****	8.95	8.86
8	22.3	23.3	7.2	19.0	****	0.23	0.59	9.03	1.34	0.74	0.69	0.04	1.26	0.29	0.10	0.05	87.0	4.0	****	8.99	9.30
8A	24.3	23.6	8.6	****	****	0.15	0.42	7.82	1.88	0.76	0.76	0.04	0.94	0.39	0.10	0.06	117.0	4.4	****	11.26	8.90
9	26.9	22.6	9.8	14.5	****	0.26	0.48	12.32	1.40	0.78	0.55	0.04	0.59	0.39	0.11	0.07	129.0	5.0	****	12.59	11.21
10	30.6	22.5	8.0	17.5	****	0.14	0.36	9.16	1.02	0.48	0.45	0.04	0.59	0.39	0.13	0.09	136.5	4.1	****	10.06	10.05
10B	34.0	22.6	10.5	16.0	****	0.20	0.38	7.77	2.05	0.48	0.45	0.04	0.32	0.43	0.17	0.14	159.0	3.7	****	10.79	8.60
11	38.0	22.7	9.7	17.0	****	0.21	0.47	8.52	3.29	0.48	0.44	0.04	0.31	0.44	0.20	0.17	139.5	3.6	****	9.30	7.68
12	42.5	22.4	8.0	18.0	****	0.92	1.60	7.48	1.94	0.38	0.37	0.04	0.25	0.40	0.17	0.17	75.0	2.2	****	8.90	7.90
13	45.8	22.6	8.4	23.0	****	1.55	2.62	6.31	1.99	0.38	0.35	0.04	0.20	0.33	0.10	0.10	57.0	1.9	****	7.07	7.13
14	52.4	20.7	14.0	19.0	****	3.54	5.85	5.56	1.13	0.48	0.42	0.04	0.20	0.45	****	0.28	28.5	1.2	****	6.16	5.97
15	58.6	22.5	6.2	27.0	****	4.78	7.85	5.77	3.07	0.55	0.55	0.04	0.17	0.40	****	0.27	25.5	1.4	****	6.06	6.21
15A	62.8	22.1	7.7	26.0	****	6.50	10.60	3.80	1.88	0.48	0.42	0.04	0.17	0.36	****	0.30	16.5	0.7	****	5.34	5.46
16	67.4	22.6	4.0	40.5	****	7.33	11.88	6.09	1.27	0.36	0.34	0.04	0.15	0.33	****	0.31	12.0	1.5	****	4.67	4.79